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NATIONAL MUSEUM
10 JUN 1975
OF VICTORIA

ADELAIDE PHILOSOPHICAL SOCIETY.

REPORTS AND TRANSACTIONS

FOR THE TWO YEARS ENDING 30TH SEPTEMBER, 1872.

ADELAIDE:
PRINTED BY ANDREWS, THOMAS, & CLARK, GRENFELL STREET.

1873.

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ADELAIDE

PHILOSOPHICAL

SOCIETY.

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FOR THE TWO YEARS ENDING 30TH SEPTEMBER, 1872.

Officers for the Past Year:

PRESIDENT:

HIS EXCELLENCY SIR JAMES FERGUSSON, BART.

VICE-PRESIDENTS:

RUPERT INGLEBY. | C. A. WILSON.

REPRESENTATIVE MEMBER OF THE BOARD OF GOVERNORS:

C. TODD.

TREASURER:

J. HOWARD CLARK.

HON. SECRETARY:

C. W. BABBAGE.

ADELAIDE:
PRINTED BY ANDREWS, THOMAS, & CLARK, AT THE "REGISTER," "OBSERVER," AND "JOURNAL OFFICES,
GRENFELL STREET.

1873.

ANNUAL REPORTS AND TRANSACTIONS

PHILOSOPHICAL SOCIETY

ADELAIDE

Adelaide Philosophical Society.

OFFICERS FOR THE ENSUING YEAR:

President:

HIS EXCELLENCY SIR JAMES FERGUSSON, BART.

Vice-Presidents:

HIS HONOR SIR R. D. HANSON. T. D. SMEATON.

Representative Member of Board of Governors of South Australian Institute:

C. TODD, C.M.G.

Treasurer—J. HOWARD CLARK. Hon. Secretary—C. W. BABBAGE.

Honorary and Corresponding Members:

SIR H. E. F. YOUNG
B. H. BABBAGE
J. HOWARD CLARK
E. DAVEY
G. F. FEINAGLE
A. GARRAN
O. HAMMOND
H. HULL
J. LITTLE
M. MOORHOUSE
C. A. WILSON
J. L. YOUNG

Ordinary Members:

HIS HONOR SIR R. D. HANSON
SIR J. H. FISHER
HON. T. ELDER
ALEX. HAY
HON. J. HART, C.M.G.
J. RIDDOCH, M.P.
D. ADAMSON
C. W. BABBAGE
RICHMOND BAKER
DR. BENSON
T. BURGAN
DR. CAMPBELL
A. S. CLARK
F. S. CRAWFORD
S. DAVENPORT
W. DUFFIELD
DR. FRANKIS
D. GALL
W. GOSSE
G. W. GOYDER
GEO. HAMILTON
W. HANSON
C. S. HARE
J. HOSKING
R. INGLEBY
R. KAY
S. KIDNER
J. S. LLOYD
J. MACGEORGE
T. MAGAREY
G. MAYO
W. S. MOORE
A. MURRAY
D. MURRAY
E. P. NESBIT
R. C. PATTERSON
T. S. REED
T. ROBIN
WALTER RUTT
M. SALOM
W. SANDERS
T. D. SMEATON
R. BARR SMITH
DR. SCHOMBURGK
W. STEVENS
C. TODD
S. S. VALE
G. VICKERY
H. H. WALTERS
F. G. WATERHOUSE
S. J. WAY
DR. WHEELER
T. G. WILLIAMS
DR. WYATT.

Victoria Philosophical Society.

OFFICERS FOR THE ENSUING YEAR:

President:

HIS EXCELLENCY SIR JAMES FERGUSSON, BART.

Vice-Presidents:

HIS HONOR SIR R. D. HANSON. T. D. SMEATON.

Representative Member of Board of Governors of South Australian Institute:

C. TODD, C.M.G.

Treasurer—J. HOWARD CLARK. Hon. Secretary—C. W. HARBAGE.

Honorary and Corresponding Members:

Sir H. B. F. Young	O. Hammond
R. H. Rankin	H. Hull.
J. Howard Clark	J. Little
E. Davey	M. Moorhouse
G. F. Fenwicke	C. A. Wilson
A. Garran	J. L. Young

Ordinary Members:

His Honor Sir R. D. Hanson	W. Coles	T. S. Hall
Sir J. H. Fisher	C. W. Cotton	T. Robin
Hon. T. Elder	Chas. Hamilton	Walter Rutt
Alex. Hay	W. Hanson	M. Salom
Hon. J. Hart, C.M.G.	C. S. Hare	W. Sanders
J. Hindoch, M.P.	J. Horning	T. D. Smeaton
D. Jamieson	R. Inderby	R. Barr Smith
C. W. Harbage	R. Kay	De. Solomonsen
Richmond Hayes	S. Kister	W. Stephens
Dr. Hinson	J. S. Lloyd	C. Todd
T. Hughan	J. Macgeorge	S. S. Vale
Dr. Campbell	T. Magarey	C. Vickery
A. S. Clark	G. Mayo	H. H. Waltens
F. S. Crawford	W. S. Moore	F. C. Waterhouse
S. Davenport	A. Murray	S. J. Way
W. Duffield	D. Murray	De. Wheeler
Dr. Francis	E. P. Nesbit	T. C. Williams
D. Gall	R. C. Patterson	De. Wyatt.

REPORT

OF THE

COUNCIL OF THE ADELAIDE

PHILOSOPHICAL SOCIETY,

PRESENTED 17th OCTOBER, 1871.

The Council of the Adelaide Philosophical Society have pleasure in presenting the eighteenth annual report of its proceedings.

The Council are still impressed with the conviction of the importance of a Society such as the present in a young colony.

They notice with pleasure the growing interest taken in the Society by the public, as exhibited by their general attendance at its meetings, the number of visitors on the average equalling that of the members, and the Council would urge upon members the desirability of inducing their friends to join the Society.

A very successful conversazione was held on 1st June, when, by the kind permission of the Board of Governors of the Institute and the Committee of the Society of Arts, the whole of the Institute, with the exception of the Library, was thrown open to the public. Interesting papers were read, illustrated by experiments; and numerous objects of scientific interest were exhibited by members and their friends.

During the past year seven meetings have been held, when the following subjects were brought before the Society's notice:—

"Causes of the Disease of Silkworms,"* by Dr. Schomburgk.

"Observations on the Rainfall at Adelaide, and the Connection between Meteorological Changes and the Yield of Wheat,"* by Mr. B. H. Babbage.

"Notes on the Palm Tribe," by Mr. C. A. Wilson.

"In support of Educational Legislation," by Mr. Jas. Hosking.

"Notes on the Progress of the Overland Telegraph," by Mr. C. Todd.

"Notes on some South Australian Minerals," by Mr. S. Vale.

"Spectroscopic Analysis," by Mr. A. S. Clark.

"Electricity," by Mr. R. Baker.

"The Flight of Birds considered in connection with Ærostation," by Mr. W. Rutt.

"Colour," by Mr. T. D. Smeaton.

During the year the Council have made fresh arrangements with the Governors of the South Australian Institute, by which the annual sum paid has been reduced to £12.

Dr. Benson has been elected a member of the Society since the last annual meeting.

The following works have been received by the Society during the past year, and added to the Library:—Journal of the Society of Arts; Patents and Patentees, vol. III., Melbourne; Abstract of Specification of Patents, Melbourne; Results of the Magnetic Survey of Victoria, executed during the years 1858 to 1864, by G. Neumayer; Statistics of the Colony of Victoria for 1869; Land and Freshwater Shells of North America; Annual Report of the Smithsonian Institute; Catalogue of Plants under cultivation in the Botanical Garden at Adelaide, by Dr. Schomburgk.

The Council would take this opportunity of urging upon members the necessity of paying their subscriptions punctually. During the past year out of sixty-two ordinary members only 34 have paid their annual subscriptions.

* Bound with the Transactions of 1869-70.

THF TREASURER IN ACCOUNT CURRENT WITH THE ADELAIDE PHILOSOPHICAL SOCIETY.

Dr.	£ s. d.	£ s. d.
October 1, 1870—		
To Balance in hand as per last statement of account		22 13 1
September 30, 1871—		
To amount received, viz.:—		
Subscriptions	33 12 0	
Proceeds of Soiree	8 14 0	
		42 6 0
		£64 19 1
October 1, 1871—		
To Balance in hand		£13 8 6

Cr.	£ s. d.	£ s. d.
September 30, 1871—		
By disbursements for the year, viz.:—		
Contributions to S. A. Institute, as agreed		12 0 0
Printing and advertising notices of meetings		7 14 6
Printing report and transactions		18 2 6
Expenses of Soiree		9 16 1
Postages and petty expenses...		3 17 6
		£51 10 7
By Balance		13 8 6
		£64 19 1

E. & O. E.
JNO. HOWARD CLARK, Treasurer.

Examined, and found correct,
J. S. LLOYD.

William Kyffin Thomas, Printer, Adelaide.

REPORT

OF THE

COUNCIL OF THE ADELAIDE

PHILOSOPHICAL SOCIETY,

PRESENTED 17th OCTOBER, 1871.

The Council of the Adelaide Philosophical Society have pleasure in presenting the eighteenth annual report of its proceedings.

The Council are still impressed with the desirability of the commencement of a Society such as the present in a young colony.

They regret, with pleasure the growing interest taken in the Society by the public, as exhibited by their general attendance at its meetings, the number of visitors on the evenings (one of the monthly meetings, and the Council would here again mention the desirability of opening their rooms to join the Society.

A very successful conversazione was held on 1st June, when, by the kind permission of the Board of Governors of the Institute and the Committee of the Society of Arts, the whole of the Institute, with the exception of the Library, was thrown open to the public. Interesting papers were read, illustrated by experiments; and numerous objects of scientific interest were exhibited by members and their friends.

During the past year seven meetings have been held, when the following subjects were brought before the Society's notice:—

"Causes of the Diseases of Silkworms," by Dr. Schomburgk.

"Observations on the Rainfall at Adelaide, and the Connection between Atmospherical Changes and the Yield of Wheat," by Mr. E. H. Hallowes.

"Notes on the Palm Tribe," by Mr. C. A. Wilson.

"In support of Limoniform Legislation," by Mr. Jas. H. Stone.

"Notes on the Progress of the Overland Telegraph," by Mr. C. Todd.

"Notes on some South Australian Minerals," by Mr. S. Vale.

"Scandinavia Analysis," by Mr. A. R. Uhrig.

"The Flora of Hills considered in connection with Climate," by Mr. W. Hunt.

"Colour," by Mr. E. H. Rennett.

During the year the Council have made fresh

* Bound with the Transactions of 1870-71.

THE TREASURER IN ACCOUNT CURRENT WITH THE ADELAIDE PHILOSOPHICAL SOCIETY.

Dr.	£ s. d.	£ s. d.	Cr.	£ s. d.	£ s. d.
October 1, 1870—			September 30, 1871—		
To Balance in hand as per last statement of account		25 13 1	By disbursements for the year, viz.:—		
September 30, 1871—			Contributions to S. A. Institute, as agreed	12 0 0	
To amount received, viz.:—			Printing and advertising notices of meetings	7 14 6	
Subscriptions	36 16 0		Printing report and transactions	18 2 0	
Proceeds of Soirée	7 11 6		Expenses of Soirée	9 10 1	
	44 7 6		Postages and petty expenses	3 17 6	
	£69 10 7			£51 10 7	
			By Balance	18 3 6	
	£69 10 7			£69 10 7	

E. S. C. BOWARD CLARK, Treasurer.

Examined, and found correct.

J. E. LLOYD.

REPORT

OF THE

COUNCIL OF THE ADELAIDE

PHILOSOPHICAL SOCIETY,

PRESENTED 29th OCTOBER, 1872.

The Council of the Adelaide Philosophical Society have pleasure in presenting the nineteenth annual report of its proceedings.

The Council are glad to notice the increasing interest taken in the Society by the members and the public, as exhibited by a better average attendance at its meetings, and with a view of increasing this interest the Council offer the following suggestions :—

1st. The endeavour to effect an arrangement with the Governors of the South Australian Institute to allow the members to have access to the scientific periodicals, and other works in the library, to be studied in a room apart from the general reading room.

2nd. That the Council should proffer their services to the Board of Governors in the selection of scientific works for the Institute library. These are matters they leave to the future Council. The Council would refer with pleasure to the success which has crowned the persevering efforts of Mr. Todd, in connecting Adelaide with London by telegraph erected through a country that was until recently an unexplored waste ; considering that if the practicability of this great work was not actually first suggested at the meetings of this Society, yet the question has frequently been discussed by its members.

During the past year seven meetings have been held, when the following subjects were brought before the Society :—

"On the Government Bill for promoting elementary Education in South Australia," by Mr. Jas. Hosking.

"On the Fermentation of Grape Juice," by Mr. S. Davenport.

"The theory of Evolution" by His Honor Sir R. D. Hanson.

"An improved plan of erecting Telegraph Lines," by Mr. A. Murray.

"On the superiority of the system of Perpetual Leases," by Mr. Jas. Cumming.

"The early history of Vaccination," by Dr. Paterson.

"On the poisonous plants cultivated in the Botanic Gardens Adelaide; their properties and effects. Some remarks on the poisonous plants that appeared lately at Port Lincoln." (Living specimens of all the plants were exhibited). By Dr. Schomburgk.

During the year the following gentlemen have been elected members:—The Hon. Jno. Hart, C.M.G., Hon. Thos. Elder, Messrs. R. Barr Smith, and S. S. Vale.

During the same period the following works have been presented to this Society and added to its library :—The Society of Arts Journal; Practical hints to Emigrants intending to proceed to Tasmania; Victorian Patents and Patentees, Vol. IV.; A Journey to Musarda; Proceedings of the Smithsonian Institute, Washington; Statistics of the Colony of Victoria.

THE TREASURER IN ACCOUNT CURRENT WITH THE ADELAIDE PHILOSOPHICAL SOCIETY.

Dr.

	£	s.	d.
October 1, 1871—			
To Balance in hand as per last account	13	8	6
September 30, 1872—			
" Amount received for subscriptions to date	47	5	0
" Amount received from S.A. Institute for balance of purchase of Royal Society's Transactions	4	0	9
	£64	14	3
October 1, 1872—			
" Balance in hand brought down	£32	8	1

Cr.

	£	s.	d.
September 30, 1872—			
By sundry expenses to date, viz. :—			
Contributions to S. A. Institute	12	0	0
Printing and advertising notices of meetings	7	6	6
Printing transactions	8	18	6
Postages and petty expenses...	4	1	2
	£32	6	2
By Balance	32	8	1
	£64	14	3

E. & O. E.
JNO. HOWARD CLARK, Treasurer.
Adelaide, 28th October, 1872.

Examined and found correct,
J. S. LLOYD.

REPORT

OF THE

COUNCIL OF THE ADELAIDE

PHILOSOPHICAL SOCIETY,

PRESENTED 30TH OCTOBER, 1845.

PAPER READ BY Mr. J. HOSKING, ON TUESDAY EVENING, JANUARY 10, 1871.

SUBJECT—"EDUCATIONAL LEGISLATION."

"A subject so comprehensive as that of educational legislation might well occupy a much larger portion of time than this Society can be expected to devote to its consideration. The history and working of national systems throughout the whole of Europe and America, the variety of means employed, difficulties battled with and overcome, and amount of success obtained, even if sketched with a sparing hand, would fill a large volume with instructive reading; and possibly would go far to establish a belief that Governments, by providing means for the suppression of ignorance and increase of knowledge, have greatly advanced the social happiness, the moral and intellectual power—ay, indirectly, the religion—of the governed. How truly has it been said that 'the thought of man, when once furnished with the medium by which to make itself known, shoots electrically from spirit to spirit, whatever be their abode; while the kindling thought itself remains burning brightly as before throughout all time.' Educational legislation affords this medium, enables mind to operate on mind, and gives an inspiriting direction to a nation's will.

"It is now pretty generally admitted that a desire to add to the intelligence of the great body politic—the people—is one of the chief characteristics of the present age. Experience demonstrates that as knowledge based on sound principles spreads, so in proportion are virtue, wealth, and power increased and consolidated. In obedience to the legitimate sway of knowledge, rebellion and anarchy give place to affection and patriotism, violence to virtue and happiness, degradation and misery to the glorious outbeaming of an enlightened manhood. All things considered, the friends of progress have abundant reason to feel encouraged at the triumphs achieved, and must rejoice that there is an ever-increasing recognition of their prerogative. Influences that a half a century ago held the necks of a large portion of the earth's family within an iron yoke, enabling political despots to grind and crush at pleasure, have been swept away; and now improved systems of instruction and a healthy literature are clearing the way to a more elevated standing-ground. Even Russia, so frequently cited as an example of tyranny and wrong, is rapidly multiplying her schools for the instruction of the peasantry; and as an evidence of her increased enlightenment has within the last 10 or 12 years converted millions of her bondmen into unfettered proprietors.

"This evening I purpose considering educational legislation as adapted to our own requirements, supporting as far as possible the intended action of our Government towards inaugurating a new or amended measure. Within a brief period, as you all know, the system of education in operation here has been somewhat lengthily discussed; and possibly there are some who tire of hearing about it—who say, 'Enough has been said.' Still, however much parties, looking at the question from their various stand-points, have differed as to what we require, there has been an astonishing oneness of sentiment as to the necessity for fresh legislation. It is very clear that confidence in the present Act has fled. And, should a new and more comprehensive measure soon take its place, it is earnestly to be hoped that its superiority will be so apparent to all as to secure for it a warmer support. It is high time that things were brought to an issue. Since Mr. Reed stated before this Society that a large number of children of school-going age were on the city streets, without the blessing of education, between two and three years have for ever passed. With that period the 'school-going age' of many of these unfortunates has flown. What about their future? To provide policemen, magistrates, and gaols for them is but poor compensation for the loss. Can the Board of Education, can the Government, standing *loco parentis*, plead anything in extenuation for their apathy in not seeing that these beyond all others were made provision for?

"I think it is a matter deeply to be regretted that prompt action was not taken by the friends of education immediately after the publication of the report of the last Select Committee of the House of Assembly appointed to enquire into the working of the Education Act. I have carefully read the evidence of the gentlemen examined by that Committee, and must say that I think it justifies the report. It was found that the Education Act of 1851 was no longer sufficient for the wants of the colony, and that money and energy were being wasted; that a large proportion of children between five and fourteen years of age did not attend any school; that the method of drawing the whole of the subsidy to licensed teachers from the General Revenue seemed to have an injurious effect; and that teachers altogether unsuited for their work sometimes obtained the grant under the Education Board. The Committee recommended that as soon as possible a Bill should be introduced into Parliament containing the following provisions:—That districts should be founded for educational purposes, having the power to levy rates and to establish and provide for the maintenance of elementary schools. That the proceeds of the school-rate and school-fees should be supplemented by Government to an amount equal to the rate and school fees. That the schools maintained by the local rates and grants from Government should be under the management of School Committees elected or appointed directly by the ratepayers. That the Government should appoint educational Inspectors to examine and report from time to time on the provisions existing for popular education in every part of the country, and that the Minister of Education or Central Board should be enabled to compel local authorities when negligent to use their rating powers. That the stipends of teachers should be paid from a fund raised by local rates and fees, subsidized by the Government. The amount of stipends to be regulated by the capabilities of the master, as shown by certificate, the number of scholars taught, and the general results of his instruction.

"The Committee also recommended that large schools should be established in Adelaide and other centres of population, and that the instruction imparted in schools supported by local rates or grants from Government should be secular. As that Committee is still represented in our House of Assembly by some of its most active members—one being a Commissioner—it is more than probable that the recommendations will receive due consideration at the hands of the drafter of the Bill. In fact, it is noticeable that the Chairman of the Committee (Mr. Hay) very recently tabled a set of resolutions almost if not entirely identical with the recommendations made. Let us therefore briefly consider the provisions of the proposed Bill in the order in which they stand:—

"1. Educational Districts—'Having the power to levy rates for the maintenance of schools, &c.' This, it may be observed, is based, not only on what was advanced by the witnesses, but on what has so long been practised in America with great success. In carrying forward the admirable systems there, not only are the States divided into districts, but the various townships also; each having power to select a Committee for school purposes. These Committees are paid for the time they devote to the discharge of their duties, and have full

power 'to select, contract with, examine, give certificates to, and in case of need dismiss teachers; to visit all the public schools in the townships twice in the term, to see that the scholars are properly supplied with books, and once a month to enquire into the regulation and discipline of the schools, and the habits and proficiency of the scholars therein; to direct what books shall be used in the schools, subject to this limitation —*that no book calculated to favour the tenets of any particular sect of Christians shall be purchased or used*, and to require the daily reading of some portion of the Bible in the common English version.' Canada is also divided into school districts. The system in Upper Canada, so frequently extolled for its many excellencies, is deserving of something more than a passing notice here. It appears that about the year 1810 the first Parliamentary grant was made in aid of common schools, which was repeated annually till about 1840 to but little purpose. Very many neglected to send their children to school, pretending that they could not spare them, or were not able to pay the fees. In 1841 the first law, embodying the great principle of granting money to each county upon condition that an equal amount was raised by assessment, was passed. At the election in that year the new measure was severely handled, and great opposition was brought against such candidates as were known to favour it. Taxation was the obnoxious thing; but fortunately those in favour of it prevailed. The Board of Education being thus provided with funds, the next object was that of finding a man capable of spending them properly—a matter very frequently of considerable importance. In 1844 the present Chief Superintendent had the office of Assistant Superintendent offered him, which offer was accepted. Training and Model Schools were immediately established, and such an improvement was soon visible as to effect a thorough change in public sentiment. All classes gave the work of reform their earnest support, and the children of rich and poor received their instruction in the same room, and 'were to be seen,' using Dr. Ryerson's own language, 'imbibing the first elements of knowledge at the same fountain, commencing the race of life upon equal terms, and cultivating feelings of mutual respect and sympathy, which, while in no respect intruding upon the providential arrangements of order and rank in society, divest poverty of its meanness and hatreds, and wealth of its arrogance and its selfishness.' From that time to the present unqualified prosperity has attended the working of the system; and it may be remarked that nothing has tended more to increase the general interest in the work than the very rate that at first excited so much opposition. Year after year the ratepayers have voluntarily increased its amount, each cheerfully paying in proportion to his property. According to the Educational Report, issued in 1869, the amount expended for common school purposes during the previous year was no less than $1,789,332, being an increase on the previous year of $118,997. One cannot but admire the magnanimity of a people who thus provide for the instruction of their children—who thus give proof that political and religious liberty, when properly directed, is productive of true patriotism and mental and moral life. And it may well be asked whether, as means to an end, we might not safely follow examples that furnish such pleasing results. I not only believe that an education rate on property would soon become popular, but that local management towards raising and expending the funds would work exceedingly well. What a change would soon be effected in this city. Instead of being without a single public schoolroom that Government or people can call their own, large and handsome edifices would be speedily raised. A rate of twopence in the pound on city property would yield about £1,700 per annum—a sum, if supplemented by the Government, sufficient to provide for our city wants, even were the instruction to be entirely free.

"In connection with Mr. Forster's Elementary School Bill, recently made law in England, school districts form an important feature—each bound to provide for the education of its own children. As in Canada, School Boards, elected by the ratepayers, are to superintend and direct all matters connected with the establishment of day-schools, levying of rates, &c., and are quite in harmony with the recommendation of the report.

"2. Government assistance to equal in amount the rates and school-fees.—I think the ratio here asked is about the same as has been received from the Government in past years. According to the report of the Central Board of Education for 1869, the sum paid in stipends to teachers amounted to £1 1s. 3½d. for each scholar; while the amount received from parents in the shape of school-fees gave an average of £1 0s. 1½d. In recommending therefore that the proceeds of school rate and school-fees should be supplemented by Government to an equal amount, nothing more is asked than the present practice justifies; in fact, is scarcely equal to the assistance now given.

"3. Government schools to be managed by Committees appointed by the ratepayers.—I have already spoken of the important duties of such Committees, and the valuable service they render. Some appear to think that there would be a difficulty in finding men suitable, and willing to act if appointed. I apprehend no such difficulty if the new Bill provide for their appointment. In Victoria no school is recognised till a Local Committee is appointed by the Board, and the appointment notified in the *Government Gazette*. Those Committees are recommended by the parents of scholars or subscribers to the school. The following is the rule, viz.:—'That a public meeting be convened of the parents of scholars who have attended school during five weeks previous to the day of meeting, and of subscribers to the school of 10s. and upwards, and notice of such meeting is to be affixed to the door of the schoolhouse, and to be inserted as an advertisement in the local newspaper, if any be published within two miles of the school.' By a regulation of the Board the Committees of vested schools must fairly represent the different religious persuasions in the localities where the schools are situated. There must not be a majority of any one denomination—of course the cost of maintenance not coming directly out of the ratepayers' pockets the appointment of Committees is different from what it would be were the contrary the fact. But still the difficulty of finding suitable men to act would apply in the one case as well as the other. If our lawmakers give the ratepayers the privilege of electing Committees for such an important work they will experience no lack of material, nor will the scheme lack completeness through this provision finding no possibility of fulfilment.

"4. That the Government should appoint Educational Inspectors, &c.—This recommendation commends itself as suitable and proper. No such work can be expected to go on well without overlooking, and that, too, by men possessing a thorough knowledge of school life. Nor will competency alone suffice. There must be a staff of Inspectors equal in strength to the number of schools to be inspected and the distance to be travelled over. Every one must be aware that at this time there is a great deficiency in this respect. Dr. Wyatt, the Chief Inspector of Schools, in his last report, stated that the Second Inspector 'during the year travelled about 4,900 miles, paying 372 visits to 289 schools; of which 20 were made to 20 schools in the Mount Gambier District, 13 to 15 schools on Yorke's Peninsula, 77 to 43 suburban schools, and 245 to 211 schools in townships and outlying localities.' So much travelling must occupy by far the greater portion of the Inspector's time, and must compel him to reduce his schoolwork to a very narrow compass. He has but few opportunities for counselling teachers, much less for meeting the parents of the children. Yet these are very important matters in connection with the efficient working of a system of public education. Possibly the time will come when each Inspector will be stationed in a separate district, living as near the centre as possible, so as to reach the schools with but little waste of time. Mr. Dewhirst complains on account of his much travelling. In his evidence, he says:—'For every hour I am in school I may say I am two hours travelling. I have too much work to do, and too little time to do it in.' After recommending an increase in the number of Inspectors, he said, 'It would be well to give one of the Inspectors the country schools north of Adelaide, reaching up to Mount Remarkable, and one of them the schools in the South, extending down to Mount Gambier; and that the Chief Inspector should have a central duty, including the city and some of the suburbs, and the examination of the teachers in connection with the Secretary.'

"5. Payment of teachers.—'The amount of stipend should be regulated by the capabilities of the master, as shown by certificate, the number of scholars taught, and the general results of his instruction.' Nothing could be fairer than this, and I believe the teachers, at least very many of them, would hail such a regulation with great delight. With a classification according to certificate, and payment by results, all classes would receive their deserts, and an incentive would be afforded such as have a laudable ambition to rise in their profession.

"6. Instruction in Government schools.—It is recommended 'That the instruction should be secular, and that no denominational teaching should be allowed in schools supported by local rates or grants from Governments.' With certain qualifications I agree with this recommendation. By the term 'secular,' however, I certainly do not understand that instruction of that kind must be 'as purely denuded of religion as it can possibly be.' The Rev. Julian E. T. Woods in his evidence not only stated this, but said that in a school where the secular system was followed the teacher could not interfere in any way with the moral character of the child. Surely the Committee did not so interpret the meaning of the term, or they would not have recommended it. One of the Inspectors (Mr. Dewhirst), in his evidence, said—'But while I say that teaching should be purely secular, I do not mean to exclude the truths of natural religion, such as the being and perfections of God; and the moral duties of religion—the duties of truthfulness, honesty, obedience to parents, and charity to the miserable. I think these duties, as a matter of course, should be taught.' Perhaps 'unsectarian' would be a better term than 'secular' for expressing the meaning of those who so explain it. I have always considered that under a system of secular instruction children could be taught those things that fit them for life's duties, including lessons on Christian morality and virtue, but certainly nothing denomina-

tional. The duties of the State being widely different from those of the Church, this is the kind of instruction no doubt that it will desire to promote, refusing assistance to any other. We want a system that will unite the masses, not divide them. The State may try to clear the brain of its people, may direct their morality; but if there be patronage towards religious organizations, offence will surely follow. Secular instruction is not conducive to irreligion. The Vicar of Suffolk, Chaplain-in-ordinary to the Queen, in a paper read a short time since in the Birmingham Town Hall, said, when referring to a visit he had made to America —'Among other matters my attention was naturally very much directed to whatever had any bearing on the religious question. I everywhere saw clear evidence of the strong religious feeling of the native population, brought up almost to a man, not merely in unsectarian, but in secular schools. Wherever I went I saw and inspected schools of this kind, and no others; on the prairies of the West, and the Rocky Mountains, as well as in Massachusetts. But the first buildings that met my eyes, almost in every place, were the churches at Denver, beyond the prairies and the plains, and further on in the little mining towns in the Rocky Mountains, as much as in Boston itself. And we must remember that these churches have been built, and that their ministers are supported by those who were all the while very busy in clearing away the forest and reclaiming the wilderness and raising the first shelter for man. As a general rule in the country I am speaking of, where all the schools are secular, the foundations of the homestead and of the House of God are laid simultaneously. I believe that a larger amount of money is raised every year by voluntary contributions for religious purposes in the United States than over the whole Continent of Europe.' Whether this belief be well founded or not, the testimony in favour of secular instruction is most valuable. By the new Bill in England, after a very lengthy and able discussion, it was enacted that religious teaching is to have no place in the school-room during the hours for secular instruction. It may be given, however, before and after.

"Before any new Education Bill is passed by our Parliament two things will no doubt receive careful consideration—1. Shall the education of the poor and destitute alone be provided for? 2. Are we to have a national system that will inaugurate a scheme of education equal to the requirements of all ratepayers? If we limit our endeavour to the narrow compass of the first, surely but little commotion will be necessary. To provide for the poor is imperative under the present Act, however illiberally the clause referring to them has been carried out. It is scarcely possible, I think, that anything short of a national system will be considered worthy of fresh legislation, and it is well known that all classes expect it. The Church of England, Wesleyan, Independent, Baptist, and other religious bodies ask for something better adapted to the requirements of their people than the Act of 1851, not something less adapted.

"Nor need it be supposed that this dissatisfaction arises from any recent action elsewhere. The shortcomings of our educational system have long formed the subject of serious comment. More than 12 years ago the Rev. Canon Farr, M.A., Head Master of St. Peter's College, in an address, said—'I would cordially support any hearty effort to improve the education of the colony. Of all measures half measures are the worst. They win no sympathy; they excite no enthusiasm. The impression they produce is one of vague wearisome dissatisfaction. Let us ask our Government, if they mean to aid in the education of the colony, to give serious attention to the subject, and to submit to Parliament some measure which may at least prove that they are in earnest.'

"In contending for a new Bill, it must not be considered as a reflection on the Act of 1851. That Act has served its day. For a considerable period after it came into operation it effected a great amount of good. Within the first 10 years the number of scholars at the public schools increased from about 3,000 to more than 10,000, and no doubt, had the Government met the wishes of the Board by granting money equal to the requirements of that department, results would be different from those now seen. Towards improving the teachers and the schools, the Board asked for means to put that clause in force which says, 'There shall be in the City of Adelaide, or in some place adjacent thereto, a normal school or training institution, under the control and regulation of the Central Board of Education, for educating and training persons of both sexes in the qualifications, intellectual and moral, necessary to make good and efficient teachers.' The urgent necessity for this has been zealously set forth by the Chief Inspector of Schools in his reports, but all to no purpose. It is strange that though so many thousands of pounds have been so freely voted for the establishment and maintenance of schools, the science of teaching has been so neglected. This is generally deemed of the highest importance towards the successful working of educational systems among older communities, whatever level it takes here. A writer in the *Leisure Hour*, speaking of the importance of training teachers for their work, says:—"The Prussian teacher has no book; he needs none. He teaches from a full mind. He observes what proficiency the child has made, and then adapts his instruction both in quality and amount to the necessity of the case. He connects each question with all kindred and collateral ones, and shows its relation to the every day duties and business of life. By these means the children are amused and interested in their studies. They go to their school with the same pleasure as a child to its nurse when expecting to hear a story told. Throughout their after-life the school days are a happy recollection, and all that was learned there is cherished and loved, because it awakens agreeable, happy, and virtuous recollections.' Under the new Bill it is hoped that both training and model schools will receive due consideration, and that before long the reproach of having any teachers unfit for the work in which they are engaged will be for ever wiped away.

"The question now arises—in what way could legislation be assisted by parties out of the House? I would say by endeavouring to make the provisions of the new Bill well understood by parents generally. A question of such importance is worthy of reference to the country, and therefore due time should be given for its consideration. In Canada, when new measures bearing on the educational department are about to be considered by Parliament, the Superintendent of Education sends out a circular, giving the fullest information possible respecting them. He then holds conventions of teachers and other friends of education, for the purpose of conferring with them. Those meetings are generally held at such times and places as are likely to command a good attendance. Resolutions are submitted that the opinions of those present may be arrived at, and thus the voice of the people is heard before the propositions become law. Our usages debar us from doing things after that fashion; but might not an Alliance be formed to watch proceedings? I think such an organization, made up of representatives from religious and secular bodies, would have an influence for good.

"Before I end my paper I would express my admiration of the set of resolutions drawn up and published by the Committee of the Wesleyan Church. With one exception—viz., the compulsory reading of the Scriptures—I believe them well adapted for general adoption.

"In conclusion, I venture to say that this Society, having already expressed itself in favour of fresh legislation on education, will watch with considerable interest the introduction of the new or amended Bill."

Andrews, Thomas, & Clark, Printers, Grenfell Street, Adelaide.

PAPER READ BY WALTER RUTT, ESQ., C.E., ON TUESDAY EVENING, JULY 11, 1871.

SUBJECT—"THE FLIGHT OF BIRDS, CONSIDERED WITH REFERENCE TO AERIAL NAVIGATION."

Mr. WALTER RUTT, C.E., commenced by by stating that they were in the habit of speaking of all animals other than those of the human species as the lower animals; but as to being provided with weapons offensive and defensive, swiftness of foot, strength, sight, smell, protection from the weather and the assaults of his enemies, man was worse off than most human animals. He had, however, been endowed with the intellect which enabled him to provide himself with appliances superior to those of any other animal. In many ways he had supplied his natural deficiencies; but there was still one great thing wanting—he could not fly. Was that always to be the case? It was true that for two or three thousand years man had made continual efforts to obtain the power of flight, and had failed; but it was also true that the motions of birds, bats, and insects were affected by the same laws which controlled the rest of the universe, and it could only be the want of a just understanding and a proper application of those laws that had so long foiled his attempts. Many of the plans proposed bore a superficial resemblance to nature without being designed with any reference to the true principles of flight. Such a plan was that shown in the drawing of a flying man in a book entitled "La De'converte Australe," by Rétif de la Bretonne, and published in the last century. The absurd arrangement of the wings, notwithstanding their outward resemblance to those of a bat, was self-evident. To avoid this error let them examine the phenomena of natural flight, and the structure of the apparatus therein employed. In the first place, no heavy bird could rise vertically. During the voyage from England to this colony he paid special attention to the motions of the albatrosses and other large sea birds, and noticed that they invariably left the water while on the crest of a wave, and even then they were compelled to get up their speed by swimming and using their wings for some time before they could support themselves in the air. When, however, they were once fairly on the wing they would skim along with motionless pinions for four or five minutes, and then one or two slow strokes were sufficient to restore the velocity they had lost, and to enable them to enjoy another period of absolute repose. As to the structure and form of the wings of birds, bats, and insects, the first peculiarity that struck them was that the front edge was in all cases rigid and unyielding, the wings gradually increasing in stiffness towards the rear edge. It was this increased elasticity which imparted a propelling force to both the upward and the downward stroke. As to the size and form of the wings, they found that the proportion of the wing surface to the weight of the animal varied from two square feet to half a square foot of wing surface to each pound carried, and that one square foot to a pound might be taken as a fair average for good flyers, this being the proportion in animals as dissimilar as the pelican and the bee. This area was in the strongest flyers disposed in length rather than in breadth. It was evident that the more rapid the advance of the bird the more nearly might the inclination of the wings approach to the horizontal, without losing the support of the upstroke. He next spoke of the method by which the bird changed the direction of its progress, or, in other words, its mode of steering. It was not effected by the tail, which remained motionless while the bird was sweeping round in curves, but the bird inclined the axis of its wings towards the side to which it wished to turn, and the two wings being thus presented to the air at different angles the required result was obtained. The most important, and at first sight the most incomprehensible, point still remained for their notice, and that was the soaring power. In order that the bird's motion might be truly horizontal, the wings must be slightly inclined, so as to give it a tendency to rise exactly equal to the tendency to fall, due to the action of gravity. In striking opposition to the case with which support was obtained during progressive flight was the difficulty experienced by all birds in sustaining themselves in the air without progression. He showed by a diagram the direction and imaginary magnitude of the forces which maintained the bird *in equilibrio*. It would be seen that if there was no wind, a much greater exertion was required on the part of the bird. It was often asserted that birds must exert an enormous power to sustain their weight in such a yielding medium as air, and the great development of the pectoral muscles in support of this assertion was referred to. It was, however, quite an error to imagine that the size of the pectoral muscles was any measure of the force (or energy) expended during flight. The weight of the bird acted downward at its centre of gravity; the resistance of the air acted upwards at the centre of pressure of each wing with a force equal to half this weight. In order to keep the wings and the body rigid, an immense tensile strain must be thrown upon the pectoral muscles; but this was entirely a static force, which might be measured in pounds, and must not be confounded with energy, which was measured by work done, or pounds raised one foot high. In fact, this function of the muscles would be performed equally well by two cords of hemp, indiarubber, or other dead substance which would obviously be incapable of exerting any energy whatever. The ultimate origin of all animal force was the food consumed by the animal. Speaking generally, it must be admitted that birds eat more than men in proportion to their weight, but the higher temperature of their bodies, and their more prolonged activity, would account for a great part, if not the whole of this excess; and he was led to the conclusion that the amount of energy available for each hour's flight did not proportionately exceed that expended by a man in walking for the same length of time. Dr. Smyth had made some experiments with a view to determining the amount of force which the wings of a pigeon were capable of giving out. The result showed an expenditure of 120 pounds per minute, being at the rate of ½-horse power for every 100 lbs. supported. As to the variance of the result from that obtained from a consideration of the food of the bird, he remarked that it was well known that a sheet of ice might be so thin as to be unable to bear the weight of a man standing on it, and yet it might be perfectly safe for the same man if he was skating over it at a high speed; and again, it had been found that the blades of a steamship screw propeller had as great a hold on the water when rapidly rotated as if they extended over the entire area of the circle of which they formed only two small sectors. Having quoted from a paper by Mr. Wenham, published in "Transactions of the Aeronautical Society of Great Britain," in support of these arguments, he said that they saw from these experiments that the greater the mass of air over which the pressure was spread in a given time the less was the force required to sustain the weight. They must not imagine that they were thus creating force; they were only not wasting it. If they took a bearing upon a small surface they set into rapid motion a large column of air; if they spread their bearing over a large surface the velocity imparted to the air was diminished, and thus waste of energy was avoided. That this was the case with birds in quick motion was evident from

the fact that in a flight of ducks no bird in any way interfered with the motions of his companions, and that a swallow would skim close to the surface of a pond without creating sufficient wind to ruffle it. Let them apply this principle to artificial flight. A weight of 150 lbs. supported on an area of 150 square feet would, according to Smeaton's tables, fall through the air with a velocity of 21 feet per second, the accelerating force of gravity being then absorbed in giving motion to the surrounding air. If a horizontal motion be given to the supporting area, so that the weight acted upon a larger surface of air, the velocity imparted to the air was diminished, and the rate of fall was lessened. Let the 150 square feet of supporting plane be in the form of a parallelogram 120 feet long and 15 inches wide, and let it be propelled broadside first at the rate of 30 miles an hour, or 44 feet a second, then the area of the air acted upon in each second would be 120 feet x 44 feet=5,280 square feet instead of 150 square feet, as when the surface was at rest, and the rate of fall would be found by the following proportion:—5,280 square feet: 150 square feet: : 21 feet per second ; 6 six inches per second. If, therefore, they wished to maintain the weight at a constant level, they must incline the plane at such an angle as would tend to make it rise 6" in 44 feet, or $\frac{1}{6}$ of an inch in 15 inches, the width of the plane. Now, a plane 120 feet long would be unwieldy to construct and difficult to maintain in shape without putting in so much material to stiffen it as would add greatly to the weight; but it was not necessary that the whole of the supporting area should be in one plane. When they remembered how thin a stratum of air was affected by the wings of birds, they were enabled to divide the plane into six separate portions of 20 feet each, which might be superposed, and their six air planes would be in a similar position to the wings of six birds in a flight of ducks or pelicans, which were skimming along one above the other without in any way interfering with each other's support. A framework of this description, but of slightly smaller dimensions, in which the air-planes were composed of strong holland stiffened with crinoline steel, was taken out by Mr. Wenham one day when there was a strong wind blowing, and it actually lifted him from the ground. They had seen that if their planes could be propelled through the air at the rate of 30 miles an hour it would support a weight of 150 lbs. Let them see what force must be expended to obtain this velocity. The projection of the air-planes on a vertical plane was 120 feet by $\frac{1}{6}$ inch, which amounted to only $1\frac{3}{4}$ square feet. Taking 10 square feet as the total area of a vertical section of the man and apparatus, shown on the diagram, corresponding to what would in naval architecture be called the midship section, the resistance of the air at a speed of 30 miles an hour was $4\frac{1}{2}$ lbs. per square foot, or 45 lbs. on the whole area. Allowing 10 per cent. for slip, they got 50 lbs. as the force required to be continuously exerted in order to produce the required velocity of 30 miles an hour. This propelling force Mr. Wenham proposed to obtain by means of small wings, composed on the principle of bats' wings, of a membrane stiffened on the front edge and stretched over a series of elastic ribs, so that a simple up and down motion would give a strong forward impulse. They were to be worked by the action of the feet, a cord from the treadles producing the up stroke and a pair of springs the down stroke. This arrangement would he (Mr. Rutt) believed answer satisfactorily, if it could at once be started in mid air; but starting was one great difficulty, and alighting again in safety was another still greater difficulty. In 1867 a patent was taken out by Mr. Kaufman, of Glasgow, for an areomotive machine on this principle, a perspective view of which was shown on a diagram. The necessary support was given by a series of air-planes, and the propelling force by a pair of long wings, which might, he thought, be advantageously replaced by a screw. The steering both in a right and left and in an up and down direction was effected by the tail-like appendages, the angle of which could be altered at will. The source of power was an ordinary tubular boiler, and Mr. Kaufman proposed to effect his start by putting the engine in gear with the wheels with which his machine was furnished until sufficient velocity was obtained to enable the air-planes to lift the apparatus from the ground. When fairly in flight the bob at the end of the telescopic tube was to be lowered, so as slightly to lower the centre of gravity, and so give more stability. The machine was to act as a locomotive, and to draw after it a train of carriages furnished with its own air-planes. He had not heard authentic accounts of any experiments having been made with this machine, but he firmly believed that it was based upon right principles, and that it was at any rate the germ which would one day develop into a workable aeromotive engine. Human mechanism always compared unfavourably with the mechanism of nature, and the machinery of flight would form no exception to the general rule. The living wing was furnished in its nervous system with an admirable means of proportioning the force and length of the stroke, so as to obtain the maximum useful effect with the minimum expenditure. Deprived of this ever-watchful and ever-active regulator it became no better than an artificial wing. They could not give nerves to their aerial mechanism, and they must therefore be content to work with a greater waste of power than nature; but this was no more than they had to do with all machinery. Their factory engines, locomotives, steamships, all worked with an expenditure of power vastly in excess of anything that they could find in the animal world, but still they did their work well, and he saw no reason to despair of the success of artificial flight. Some of them might yet live to see aerial trains skimming along the frictionless plains of the air—a truly permanent way, the rails of which were supplied by nature, and needed no repairs, and which would meet without danger of overcrowding the requirements of any amount of traffic.

Andrews, Thomas, & Clark, Printers, Grenfell-street, Adelaide.

PAPER READ BY Mr. J. HOSKING, ON TUESDAY EVENING, OCTOBER 17, 1871.

SUBJECT—"The Government Bill for Promoting Elementary Education in South Australia."

Mr. James Hosking, pursuant to notice, read his paper on the above subject. The following is a brief abstract. Acknowledging that thanks were due to the Government for undertaking educational reform, and that some of the points which had previously been discussed by the Society were dealt with in their Bill, he asserted that some of the most difficult questions had not been grappled with, local rating specially not even being alluded to. While such clauses of the Bill as bore on religion and some others were shut out from discussion by the rules of the Society, there were others which they might be glad to give an opinion on. Hitherto legislation on this subject had been tardy, and although they lived in a country abounding with treasures, and in which their freedom from influences oppressive in older countries should give elasticity and vigour to efforts for the public good, yet their institutions for perpetuating knowledge were lamentably deficient in contrast with those of some other British Colonies—notably those of the western hemisphere, where, instead of alienating the lands of the people as opportunity occurred, they with great wisdom and foresight had first set apart large tracts for the maintenance of educational institutions. Had the founders of this colony acted on this principle long ere this funds would have accumulated that would now have been of immense benefit in the working of a national system. Till Major Robe's time little was done towards furthering instruction, and in 1847 out of a population of 30,000 only 1,300 children attended the public schools. In 1851 the report of a Parliamentary Committee led to the passing of Act No. 20, as to the working of which little need be said. Though 20 years had passed, normal and model schools, a pupil-teacher system, classification of teachers, gradation of schools, &c., &c., were things of the future, and the state of education throughout the colony far below what it should be. Nobody being satisfied, the Government were fully justified in stating in the preamble of the Bill that "it is expedient to provide for elementary education." If he understood the Bill, one class of the community was to be honoured by special legislation, as the 23rd clause provided that in Adelaide and other centres of population national schools might be established for the children of the poorer classes, which caused the idea to press on the mind that the system was not intended for all classes, as he should prefer it to be. He saw no necessity for so dividing the community as to impress the idea on any that they were objects of the State's charity, and felt certain that more liberal and statesmanlike measures might be adopted, by which much of the incubus of class and party would be shaken off. He quoted from a speech of Mr. Roebuck as to the benefits that would result from such a system being established in England as that the son of the squire might be able to sit on the same bench with the son of the peasant, thus raising up kindly feelings between class and class. Apart, however, from the question of the wisdom of this class-legislation, he asked whether the teachers or the parents should be judges as to who should be admitted to the schools. The former could not judge, and the latter would send children who could afford to pay a higher fee. He would meet the difficulty by establishing schools which would be open to all alike, as was the case with the elementary schools even in England. But why limit our system to the elementary? Would not the people—the ratepayers—esteem a gradation of schools that would secure a higher standard of education, and would they not tax themselves for its support? He thought that the best plan of raising funds was that adopted in America, where the property of all is taxed; in some States the Banks were taxed 1 per cent. on their capital, while in others 25 per cent. of the amount received for spirit licences and the fines for statutable offences went to the school fund. In New Zealand a uniform rate of 10s. on each householder and 2s. 6d. for each child was imposed. But this he thought objectionable; at all events if our Government had the right to establish a comprehensive system of education, every one should aid cheerfully according to his means. Taking the population of the colony at 185,000, and the children at 35,000, after deducting 5,000, who would for some years attend private schools, there would be 30,000 to provide for, whose education would cost at least £2 per head, or in all £60,000 per annum. In England the cost was 30s. per head; in Victoria, 40s.; in Queensland, 49s.; and in South Australia about 40s. Of this sum an eightpenny rate would produce a little more than half, leaving £28,666 13s. 4d. for the Government to provide. Or, taking Adelaide alone, 5,000 children would cost £10,000. A Government subsidy of say £5,000, and an eightpenny rate £7,066 13s. 4d., would leave £2,066 13s. 4d. to meet interest on outlay for buildings. According to the average assessments a man having a cottage rated at £20 per annum would by paying 13s. 4d. a year have free education for all his children. This might be a voluntary tax, and the officers of the Corporations and Councils might collect the money, and parents might be exempt whose children attended private schools. That only the children of the poorer classes would attend these schools was disproved by experience in America, and if the system became popular here Government would see that excellence should not be lacking in their schools any more than in their telegraphs and railways, so that these schools would serve as models for private teachers, and exercise a powerful influence for good. He highly approved of the portion of the Bill which provided for normal schools, which with a model school was absolutely necessary; indeed, where such were looked on as essential an untrained teacher would not be found, and he considered that a capacity for imparting knowledge as well as possessing it was necessary. Tests of fitness for teaching were becoming increasingly severe, as in a country like this where the opportunity of getting instruction was often very limited the waste of a year or even of a month would produce incalculable mischief. He would not deny that there were teachers an honour to their profession who had not received normal school preparation, but they would be still better if trained. But if good schools were established all over the colony, unless compulsory measures were enforced the children most requiring education would not receive it, as many parents would not appreciate the interference of those who would awaken them to a sense of their duty in this respect. The Bill was far too mild, and the Canadian Act, by which any Magistrate was empowered to impose a fine of five dollars for the first and double for each subsequent violation of the School Act, unless caused by extreme poverty, &c., met such a grievance as brutalized neglect. The term "British freedom" should not be applied to such criminality as attached to neglect of offspring, which was that sort of liberty which entailed injurious results on either the actor or his fellows, and as such should be curtailed by law. The effects of vice and poverty were visible here as everywhere else, and the Legislature should adopt itself to "things as they are." On the question of school-fees, he thought that with a school-rate and compulsory clauses every barrier would be removed. Free schools were greatly increasing in favour, and in the City of Berlin, in Ontario, and in Queensland school-fees had been abolished, and the effect had been most remarkable. There were some who contended that free education would not be esteemed, while others raised a cry about its pauperizing tendency; but facts did not bear out these views. Under the system proposed the Commissioner of Crown Lands was to be President of the Central Board of Education; but he contended that the Chairman of such a body should be a man thoroughly conversant with the theory and practice of education. He preferred having a paid Chairman, like the Chairman of the Destitute Board. In large centres he thought that larger schools would have to be established, to be conducted by men of high training and judgment; but it would never do for the masters' salaries to be limited to £220 per annum, as in this Bill. The 31st and 32nd clauses of the Bill would no doubt be altered in Committee, as they were unworkable, and teachers would not be compelled to attend to evening classes. There were other points which had been fully discussed at previous meetings of the Society. In conclusion, he trusted that the

new system would command such confidence and support as to add to the strength of the State; that under its gradation of schools merit would take the highest position; and that lasting friendship would spring up between youths of all classes, based on something better than the chink of gold.

The CHAIRMAN deprecated any religious element being brought into the discussion which might ensue.

Mr. C. S. HARE, in moving a vote of thanks to Mr. Hosking for his paper, with nearly all of which he agreed heartily, enlarged on the duty of the State to teach children to comprehend the written laws by which they had to be governed, and expressed his desire that they should bring all their philosophic power to bear on the question. Referring to the Chairman's remarks as to the religious aspect of the subject, he appealed to the meeting as to whether that should not be discussed.

The CHAIRMAN referred to the rules, which he decided bore him out in his view, but asked the meeting to decide if he was incorrect.

Mr. INGLEBY said the question they were discussing was the Government Education Bill; the question was whether, as political subjects were forbidden as well as religious ones, they could entertain it at all.

Mr. T. MAGAREY thought that while much indebted to Mr. Hosking, it was clear that under the rules of the Society they could not go into the Bill; and as they could not do justice to it without discussing moral as well as intellectual culture, they had better allow the subject to pass without further remark.

Mr. G. HAMILTON thought that Mr. Hosking's remarks would be legitimate subject for comment, leaving religion out of the question.

Mr. TODD was expressing a similar view, but inadvertently referring to religious teaching was called to order. He mentioned that a gentleman present from New South Wales—Dr. Garran—would be able to give very interesting information as to the working of the school system there. (Hear.)

Mr. T. BURGAN said on the whole he agreed with Mr. Hosking, although he did not think he had gone into the question so fully as he would have wished. He had been connected with the present system for many years, and he knew the good it had done. He referred to the last report of the Board of Education stating that in 1852 the number of children on the monthly roll was 2,383, and in 1870, 15,108, with an average attendance of 11,967. He believed that the schools and teachers had been steadily improving, and the Board by instituting examinations had elevated the standard of education. He considered that the cry that the present system was not sufficient was unfounded. The great drawback had been the parsimony of the Legislature. (Hear, hear.) He had hoped that the Government would have brought in a national scheme, but this was not such an one. It was class legislation of the worst kind. The Treasurer had said that the measure would benefit the whole of the colony, but before coming to the end of his speech he contradicted himself, and said that the present teachers would have to look out for themselves. The Education Board had not been asked their opinion on the matter. Mr. Jefferis had said, in his lecture on "Gladstone," that Mr. Hart had stated that the Bill would comprise the provisions of the English Act; but that was not the case. The Government did not seem to have calculated what expense the measure would entail. The Treasurer had introduced the Bill in an unstatesmanlike way by stating that the measure could be altered as the House pleased. That was not the way in which the question of education should be treated by a man like Mr. Hart. He thought it would be a disgrace to the community if this Bill were passed. It would be going back. (Hear, hear.) The measure was, as the Treasurer had said, so elastic that it could be put into any form; and he hoped it would emerge from the Assembly in a very different form to that in which it had been introduced.

Dr. GARRAN, of Sydney, said that after an absence of 16 years from South Australia it afforded him great pleasure to come among them and find a popular agitation on the subject of education in the colony. Having known something of the measure at present in operation, and having had something to do with its passing, he had seen that South Australia was not keeping pace with the other colonies. In some political matters it had been the pride of this province to set the example, and larger colonies were not too proud to follow; but in public education he did not think it had taken the lead—(Hear, hear)—but rather in this matter it had fallen in the rear. At the time the measure was passed it was about the only sort that could be passed. There was no option but for the State to leave the question alone, or to take advantage of the existing voluntary ecclesiastical institutions. He thought at the time that that was better as a rule, but a larger acquaintance with education had shown him that if it was to be of use it must be centralized—that the efficiency was in proportion to the centralization. The system in New South Wales had had the effect of shutting up a great many schools, to the advantage of the teachers and the scholars. They had been rather overburdened with small schools in localities where one would be sufficient. The consequence was that the schoolmasters were not paid proper salaries, and if they were paid proper salaries better teachers would be got. No young man would deliberately enter a profession that would not give him more than from £60 to £100 a year. By combining schools they had been enabled to offer men respectable salaries, and young men saw the chance of obtaining £300, £400, or £500 a year. All who entered the profession could not get the prizes, but the fact of there being prizes induced many to enter it. The work of education had been looked upon as a profession, and not merely as an occupation for those who could do nothing else. In New South Wales it had been observed that the best Inspectors were old teachers, and the best teachers were those who had passed through all the grades, and who had been engaged in the work from their earliest childhood, who were attached to it, and who were content to remain in it. This could only be brought about by centralization. There were perhaps evils connected with the system. Perhaps there was too much government, too much restraint on the teacher; but whatever evils there were they might be cured in time, while there was good in the scheme. The principal thing was to get large schools wherever there was a large population. In Adelaide, it seemed to him that one good school in North, East, and West Adelaide would be amply sufficient for the present wants of the community. They would be able to have one good master with a handsome salary, and to obtain able sub-teachers; but if they had 20 institutions very few of the scholars would be properly taught. As to local rating, he was sorry that they could not look to New South Wales for an example; but the Education Board in their last report greatly regretted the absence of it, and looked forward to it as the great remedy. In New South Wales, when there was nothing to do but to pull at the public purse, people had no consciences. (Laughter.) So long as Government maintained the schools the demand was very great for handsome buildings. One-third of the cost of these erections was subscribed for by the inhabitants, and handed over to the Government, but after that they did nothing. They had no interest in the buildings, and the smallest repairs had to be done by the State. There was an earnest desire to see each district have an interest in the maintenance of its school. In South Australia the admirable system of District Councils gave them facilities for centralization and localization, which he would like New South Wales to take advantage of. If it could be arranged that the buildings could belong to the District Councils, although erected under the supervision of the Board's architect, they might leave the appointment of the teacher and other matters to the Board. Persons elected to attend to the construction and maintenance of roads might not be able to manage these things, but they could attend to the building. They had an opportunity with their existing municipal institutions, which had worked so well in other matters, and which existed here, he believed, to a larger extent than in Victoria, and certainly than in the other colonies, to combine centralization and localization. If the object of public schools was to give a good primary education to all who might be brought within the reach of schools, let that object be sought as straight as possible by setting aside all other considerations as secondary, and securing the best possible education that could be got at the cheapest rate. Whatever they might like, they must let those things bide their time. The present tendency in New South Wales was towards large schools with very efficient and well-paid masters and mistresses. The majority of the population, although there were always some dissatisfied ones, were very well satisfied with the working of the present system. The schools were well attended, and the large ones were such as no town in the mother-country need be ashamed of. They were, in fact, the lions of the country, and were shown to every distinguished visitor. He did not think that they had any such lions to show in Adelaide. Whether by the Bill now before Parliament or without it, the sooner they got some large model schools in Adelaide to set an example to other districts and to train teachers the better. (Applause.) In answer to a question, Dr. Garran said that they collected fees in New South Wales, and the Board wished to continue that system, as the fees came to no contemptible sum, and the payment of them gave the parents an idea of independence. The example, however, of Queensland, where the schools were free, was infectious. The feeling in Sydney was in favour of charging fees, but if rates were adopted the whole system of levying fees would have to be reconsidered. The schools in Sydney were not only attended by the children of the poor, but by those of professional men, tradesmen, and well-to-do persons, who sent them because the schools were the best in the town. The children liked them, the teachers were competent, and the scholars learnt more and better than they would elsewhere. The parents thought they ought not to be debarred from sending their children because they had only to pay 1s. per week.

Mr. R. INGLEBY thought that if education was not compulsory a great deal of the advantage accruing from it would be lost. (Hear, hear.) They lost the training which was so necessary for the youths of this colony. A great number of children did not go to school because they were not compelled to do so.

The motion was carried, and the vote was acknowledged by Mr. Hosking.

William Kyffin Thomas, Printer, Adelaide.

PAPER READ BY Mr. SAMUEL DAVENPORT, ON TUESDAY EVENING, JANUARY 23, 1872.

SUBJECT—"THE FERMENTATION OF GRAPE JUICE."

The subject of this paper is the "Fermentation of Grape-Juice." This juice fermented, as distinguished from the fermented juices of all other fruits, is specially termed "Wine," and the qualities of that wine are greatly influenced by the character of its fermentation. And since in the relationship of man to wine—at least as regards Europeans and their descendants—our physical and moral state, and our domestic and social happiness, are more or less impressed by the wine we drink, or by the absence of the wine we ought to drink; it is hoped this subject may not be inappropriate for your consideration this evening.

In truth, "Good wine, and how to make it" constitute a possession and a science of some value, and especially so in a country like South Australia, suited by nature for its production; for good wine means good health. It is tone and vigour of both mind and body to those who use it reasonably. When readily accessible to the poor, good wine means sobriety among the masses of our population. Freely used, it controls the desire, and by its satisfying qualities banishes the appetite for strong drinks. In countries where wine is well and abundantly made intoxication is rare. The habit of intoxication probably originates in physical and nervous exhaustion, which condition of life, below par, good wine remedies, without intoxicating. Good wine in abundance effectively promotes both temperance and health; whilst bad wine is an enemy to the human race.

Referring to pure wine and London dram-drinkers, Dr. Druitt says:—"Cheap wine would cut off the temptation of gin, and, with an equal bulk of water, would in certain cases be a happy substitute for tea; for tea, which, from its astringent and sub-acid qualities, is so grateful to exhausted systems, has this intense drawback—that when taken to excess, without sufficient substantial food, it begets dyspepsia, which impels the sufferer to seek refuge in gin."

In reporting to the French Government, in 1868, Dr. Guyot—on the red wines of Auvergne—says "that in the marshes of Riom there existed endemic sicknesses of intermittent fever, goitres, &c.; but all these have disappeared since the inhabitants could habitually drink these wines at their meals."

Also, of the 4,000 inhabitants of the Commune of Aubiere, all vignerons or their families, he says:—"Their activity and power of labour are such that they work not alone their own vineyards, but two-thirds of those of Clermont;" and he adds—"All who know the vast amount of labour those can undergo who live on good wine and bread, should come to Aubiere; there they will see what force and intelligence in agriculture can be applied by man."

Professor Liebig says:—"In no part of Germany do the apothecaries' establishments bring so low a price as in the rich cities of the Rhine, for there wine is the universal medicine, for the healthy as well as for the sick, and it is as milk for the aged." Also, that "as a restorative—as a means of refreshment when the powers of life are exhausted—as a means of correction and compensation where misappropriation occurs in nutrition, and the organism is deranged in its operation—and as a means of protection against transient organic disturbances, wine is surpassed by no product of nature or art."

It is, then, good to have good wine. All bad wines are bad. If wines are made, they should therefore be well made. This is a moral duty imposed on the maker. Now, of all the labours conspiring to make good wine none is more important than a good fermentation.

"Fermentation," says Terrel des Chênes, "has been called the most important act in the wine industry;" and that "the greater part of the degeneration of wine originate in a bad fermentation." Maupin, who wrote in 1770 and 1784, is of the like belief. Chaptal affirms that fatty degeneration is caused by the extractive principle not being decomposed through a defective fermentation. Odart says that wines well made are never sick, and that the first condition of a wine being well made is a good fermentation. Guyot, Machard, and Pasteur all concur in this opinion.

In pursuit of the conditions of a good fermentation of the juice of the grape it is natural to ask—What is a grape? Why do its lacerated and mixed contents ferment? Why is the result good or bad wine? and why cannot we always secure the good and avoid the bad? And from such enquiry it will be evident that, to secure good wine, nature and art must work together. The materials to be fermented and the act of fermentation must co-operate. There must be a suitable grape, matured under a suitable climate and in a suitable soil, and gathered and submitted to an effective crushing at the right time and temperature; and there must be clean implements and an intelligent guidance of the subsequent fermentation, and the result will be good wine.

Nature and Structure of the Grape.

What is a Grape?—The grape (says Fabroni) is an aggregation of vessels and vesicles, which constitute it a kind of globular gland, in which various fluids are prepared and preserved. The ingredients of a grape, as given by Mulder in his "Chemistry of Wine," are as follows, namely:—"In the grape-juice, tartaric and malic acid; in the unripe grape, tartaric acid alone where the juice is ripe; sugar, in the proportion of 13 to 30 per cent. as an average, though 40 per cent. exists in some very ripe grapes; albuminous substances, found differently in the juice and in the walls of the cells of the pulp. In the grape-stone are tannic acid (otherwise called tannin) and a fatty oil suited for food or burning. In the grape-skin are tannin (soluble in alcohol and water) and the colouring matter of the grape. This tannin, when acted on by air, forms a brown substance called apothema, which becomes a cause of white wine darkening. In other words, white wine darkens when exposed to the air, because the tannin it holds in solution oxidizes. In the grape-stalks also is tannin in large quantities."

The anatomy of the grape is thus described by Fabroni:—

"1st. From the centre of the stalk arise two great vessels, appropriately named arteries, which convey the sap into the grape. These vessels pass up the centre, and at the top curve over, expanding themselves circularly in eight or ten small veins, which subdivide and reunite in frequent anastomoses near the surface of the grape, and, descending towards the stalk, discharge into it the superabundant sap, excrementitial or not duly prepared. These arteries, which much resemble those of the human body, are fewer in number than the veins. Their form is conical; that is to say, they grow less in proportion as they are distant from their starting-point; whilst the veins, on the contrary, grow larger as they approach their termini.

"2nd. The whole pulp of the grape is also an aggregation of very delicate little vessels, which fill the spaces of the network tissue, itself formed of a great number of extremely slender little filaments.

3rd. A longitudinal section of the grape exhibits the two arteries ascending from the centre of the stalk to the top of the grape, then curving towards the circumference, where they expand into a thousand branches, and thence descend, degenerated, as it were, to veins, towards the stalk, leaving always between them and the skin of the grape an interval containing the cortical pulp. In the middle is another kind of pulp; which seems to be separated from the cortical by a very subtile membrane. And, further, there are two pips shut up in the central pulp, united by means of a gelatinous ligature to two little projections which arise from the centre of the stalk of the grape. Thus there are three departments of pulp in the grape—the cortical, or that between the skin and the sap-vessels; the intermediate, between these vessels; and the central pulp, in which are the pips and the ascending arteries."

The physical character of the fluids of the grape is described by Fabroni as follows:—

"In the central pulp of the grape resides a gummy, mucilaginous juice; in the intermediate pulp a very sweet sugar; and the cortical pulp is composed of matter similar to the last, only it is more slightly acid. In the internal part of the skin is the resinous or colouring matter. Whilst the organic portion, solid and indissoluble—the framework of the cells—contains matter of a vegeto-animal nature, analagous to the albumen of egg and the gluten of wheat."

All persons who crush grapes with a press know that the first must, which exudes by the slightest pressure, gives the best wine. The reason is this:—Try to press the grape between the fingers, and the central pulp will come out first, with the pips, and almost without being broken. The greater part of the cortical pulp remains attached to the skin, and the intermediate pulp is that which resolves itself into fluid. In this intermediate part it is that Fabroni found the principal seat of the sugar; it is it that furnishes the sweetest must, and it is the sweetest must which yields the best wine."

Afterwards comes the further pressing. In it the central pulp chiefly is crushed, and gives also good wine, but not so sweet as the former nor as capable of duration. If still the grapes are pressed by repeated efforts, then are forced out the last atoms of the cortical pulp, remaining mostly entire, and the quantity of acid they contain can only give a sharp wine, little agreeable and incapable of preservation.

The skins, or marc, of the pressed grape, although thus pressed, contain an abundant and powerful acid, which, placed on copper sheets, soon corrodes them, and forms the salt known as verdigris.

I cannot (says Fabroni) assert that the three substances—gummy or mucilaginous, sugar, and acid—which mainly compose the grape, are perfectly isolated in these three regions—central, intermediate, and cortical. Each one shows the presence of sugar and of acid; but the predominance of each of these substances is really limited to their respective regions, and, far from being there confused and mixed, they are, on the contrary, contained in small vessels separately.

Now fermentation is the effect of a reciprocal chemical action of these substances, and that action can only take place by their actual contact.

Thus so long as the grape remains intact and the unbroken skin excludes the contact of the air, and before the rupture of the different cellules which keep separate the several substances in the grape, and prevent one acting on the other, fermentation, by which the sweet must changes into a vinous liquid, cannot occur. It follows, then, that the expressed juice of the grape passes into fermentation because it is composed of various substances capable, at a given heat, of exercising a reciprocal chemical action.

When the grape is crushed, its liberated and mixed contents enter into fermentation, and hence form wine. Nature thus makes the wine; but if nature be not seconded—if the conditions of safe conduct be not supplied it—if, on the contrary, hostile circumstances are imposed upon it—no success can attend its efforts, and the wine made will be neither good nor durable.

Hence the need of suitable rules to guide the winemaker in seconding the action of nature to secure good wine. In illustration of these rules I refer to the theory of the fermentation, resulting from the free contact of the substances contained in the grape.

Theory of Fermentation.

The two substances of which Fabroni has shown the grape chiefly to consist are sugar (also called "glucose") and a vegeto-animal matter analagous to and also called "leaven," or "yeast," or "ferment." The sugar exists separate in cellules, and the leaven separate, contained in the membranes which fill the space between these cellules. He has shown that the grape-juice, left at rest, deposits a sediment which, subjected to great heat, becomes so solid that the juice may filter from it; and he found this juice insusceptible of fermentation so long as it was insulated; but on restoring the sediment dissolved fermentation commenced. This sediment—the vegeto-animal matter—was then the germ of fermentation, and thus, from the moment when by crushing the grape these two substances are placed in contact, vinous fermentation sets in.

The process of fermentation may be generally described as follows:—The sugar and the leaven liberated act and react on each other. As a consequence each undergoes decomposition. The sugar decomposing is resolved into carbonic acid gas and alcohol, in nearly equal proportions. Its evidences are bubbles of gas, which thickly form and rise at all points of the fermenting mass, which by degrees loses its sweet taste and assumes the smell and taste of wine; and the leaven decomposing forms a froth on the top, and a fibrous deposit of its emptied cells at the bottom of the fermenting mass; meantime the liquid grows clear. After this the fermentation relaxes, but it may be revived by well stirring up the froth and deposit. Eventually the froth and deposit are composed almost exclusively of leaven, and its cells become insoluble.

That fermentation is most perfect where the relative proportions of sugar and leaven have been such that, when completed, neither sugar nor leaven remains. If one is in excess, and therefore survives the other, one of two results occurs—namely, where sugar survives the wine is sweet, a liqueur wine, and there is no fear of its turning acid; where leaven survives, some means are necessary to stop the fermentation, otherwise it will carry on, for its subsequent action is the destruction of the alcohol it had previously joined in producing, and which it now greedily seeks to convert into acetic acid.

The study and successful working of the means for removing or neutralizing the leaven surviving after the decomposition of the sugar appears to constitute a labour in winemaking of the most intricate, but at the same time the most interesting nature. To control or destroy the life of such leaven is the one object of all the subsequent treatments of sulphuring, brandying, racking, sugaring (by musts or otherwise), heating, freezing, hermatic sealing from the oxygen of the air, &c.

And here it is evident that often, unconsciously, one winemaker may succeed in making sound wine, whilst another, equally careful, sagacious, and persevering, makes sour wine, for in some kinds of grape the sugar predominates over the leaven. In such cases the must has only to be fermented, and the leaven, being weaker, has all vanished. In other kinds of grape the leaven predominates, and here, unless art successfully steps in, the result is a sour wine. Hence Machard lays down so valuable an instruction that winemakers should grow only such a variety of vine, or such a combination of varieties, as will, in their climate and soil, yield musts with sugar and leaven duly proportioned, as well as other subordinate substances of the grape. Cazatis Allut says—"The first condition for good wine consists in the choice of good grapes and their suitable cultivation. A good grape, well grown and fabricated, is the soul and body of good wine."

Of Sugar in the Grape.

Chaptal says the taste is no guide to the relative proportions of sugar and leaven, for the leaven itself is sweet, and hence no one can thus judge the quantity of sugar contained. Then what guide have we in selecting grapes for wine? Chiefly the practice and experience of established vineyards. Dr. Arthaud, on "The Vine and its Products" (Bordeaux, 1858), in further illustration, says:—"For the vat the grape should be perfectly ripe, which is when the sugar and colouring matter are fully formed; and since uniformity of ripeness varies with kinds of grapes, their combination for one wine threatens to derange a common maturity. One of the marked causes of the superiority of our grand vineyards is in the few kinds of grape planted in combination. Four or five kinds of vine, known as of the highest quality, suffice. In Medoc, the celebrated vineyard of Brannes-Mouton, which at this time (1858) is one of the most brilliant jewels in the golden crown of the house of Rothschild, has but one kind of grape—the Carbernet. It is difficult to estimate how much the wine may suffer from an indiscriminate mixture of grapes."

The following extract from a recent work of Guyot's is instructive on this point. Commenting on how many kinds of grape there should be in a wine, Guyot (p. 577, vol. i., "Etude des Vignobles de France") asserts that "It is impossible to make a good wine with more than four kinds of grape united;" "three are better than four, and two than three." Facts may establish this assertion. Thus—"The Medoc wines are composed of four grapes—the Carbernet, Malbec, Merlot, and Verdot; the Emilion wines are made of three kinds of grape—the Bouchet, Black Pressac, and Merlot—the same as those of Medoc, but by other names, less the Verdot; Champagne wines of Plant doré, Plant vert, and L'Epinette blanche (three); Santerne, of the Semillon blanc and the Sauvignon (two); Hermitage, of the Shiraz and the Roussaune (two); Côte-Rotie, of the Serine and the Vionnier (two); the dessert wines of Monbazillac, of the white Semillon and the Muscat fow (two); all the fine Burgundies, of the Pineau noir alone; Chablis, of the white Morillon alone; the Montmelian wines, of the Mondeuse alone; the Beaujolais wines, of the little round, grained Gamay alone. I do not know," he adds, "a single wine of note which is produced from more than four kinds of grape in union."

Each grape has its own special qualities; each produces a wine peculiar to itself, and there are very few that harmonize and associate in the vat as well as they do on the vine. All efforts, all vine-growing and winemaking, ought to tend to simplify the conjunction of vines in the making of wines.

Sometimes certain combinations of different kinds of grapes are useful—necessary even. For example, the association of white grapes of fine quality with red grapes, in a certain proportion, will give *eclat*, life, generosity, and durability to the wine. Some grapes have more bouquet and generosity, in which others are deficient, which are softer, more highly coloured, and more bodied, hence a combination of kinds can complete a better wine; but the preference should always tend towards one grape. The Pineau, Muscat, Tokay, and Shiraz wines have their special bouquet invariably, because they result from one grape.

If you have difficulty in choosing grapes for wine, take simply the cuttings and kinds of the best vineyards. But if the object in vine-culture be to grow the best juice or must, so the object in wine-making is to produce the most perfect fermentation of this must.

What are the Conditions of a Good Fermentation?

As already seen, it is necessary to bring the substances of the grape into intimate contact, so that they may readily act on each other. To secure this contact we require efficient crushing of the cellules and membranes of the grape. The must should be sufficiently fluid to permit of these substances being thoroughly dissolved, so that their fermentation be uniform, simultaneous, active, and complete.

The contact of the air with the crushed must is necessary that the oxygen may start and stimulate the fermentation; but after fermentation has commenced the presence of air is injurious. Both sugar and leaven are required to generate and maintain vinous fermentation; but, as seen, their relative proportions in the must vary according to the kinds of grapes and the degrees of their maturity.

A certain temperature is necessary, and of any one vat it should be uniform. A certain length of vatting is required, varying according to the quantity of sugar in the must, and the object of the maker, whether seeking a light wine with bouquet or a strong wine with spirit and colour; and attention should be given to the management during vatting.

On these various points I note the following remarks and rules:—

Ripe Grapes.

Mulder says:—"The excellence of the wine will depend in a great degree on the maturity of the grapes, and the way in which they are gathered and treated."

If immature the grape may not have enough sugar to form sufficient alcohol, or the season by excessive wet may have induced the same deficiency by diluting the sugar with too much water. This evil may be remedied by sprinkling sugar over the must until the taste resembles that of good ripe must; if this be done it should be before fermentation begins. The ancients added honey. Or a portion of the must may be boiled down to a third of its volume, and then added to the vat. Or the grapes may be dried in the sun, or their excess of water driven off by stove heat.

If the grape be too ripe and the weather too dry, there will be excess of sugar and too little water, resulting in a thick must, whose fermentation will be slow and imperfect, and the wine sweet, liquorous, and pasty, clearing only after long sojourn in bottle. To remedy this, if a liqueur wine be not wanted, the must should be diluted with water, or artificially heated and agitated during fermentation, according as a liqueur wine or not is desired. If the season be so cold as to need it add heated must (but not to boiling point) to raise the temperature to from 54° to 59° Fahrenheit. If the temperature of the vatroom be below 54° raise it artificially.

Guyot, 1868, says:—"The grapes should be fully ripe. There is a moment with all fruits when they are best disposed to pass to a complete fermentation. If you put unripe grapes to ferment part of the juice will not do so, but will damage the rest. As long as the grape is acquiring sugar it should be left on the vine." He further says:—"In the best white wines, as in the red, the mixture of very ripe and unripe grapes causes successive fermentations, and the greater part of subsequent deteriorations; and that the most important advance in making good wine has taken place in the Herault by vintaging when their must is at 9° and 10° of Beaume, equal to 1067 and 1075 specific gravity. All green or withered unripe grapes and all rotten grapes should be rigidly kept out of the fermenting vat."

Crushing.

Terrel des Chênes says:—"The crushing of the grapes is a fundamental part in the art of wine-making, and the perfection of this operation is one of the most essential conditions of that art. It is so important that, when defective, it is impossible that the wine should not thereby have lost quality. The crushing deficient, all the subsequent life of the wine is deficient."

Chaptal says:—"It is indispensable to crush the grape in order to facilitate the fermentation. No spirituous fermentation can take place unless by a suitable pressure the sugar is extracted, and submitted to the action of causes which determine the fermenting movement. The operation of crushing is perfect only when the grapes are well and equally crushed; otherwise the progress of the fermentation will not be uniform, and the sugar of some grapes will have run the period of its decomposition before other of less perfectly-crushed grapes has commenced; and hence the elements and action of the substances in the fermenting-vat will be out of due relationship to one another."

Machard says:—"The crushing of the grape is one of the operations most necessary to a perfect fermentation. Carelessly done the fermentation following is not uniform, and when the time of drawing off comes, the wine will be found composed of parts, of which some have been too much subject to the tumultuous fermentation, whilst others have fermented imperfectly, and these will carry with them into the casks the elements of disorganization, bound, sooner or later, to produce ill results."

Guyot says:—"The crushing of the grape, be it with or without their stalks, ought to be done previous to pressing for white wines, and before vatting for red wines; and it ought to be done effectually. The object is to separate and free the different constituent parts of the grape, and to multiply their contact with the air, in order to produce a rapid and uniform fermentation, and to facilitate their perfect dissolution, and induce the best possible combination of all the elements of the wine."

Vergnette-Lamotte, 1868, says:—"It is a fact well known in all the vineyards that the good fermentations are instantaneous; and further, they know that nothing so much assists the prompt start of fermentation as a prolonged manipulation of the grapes and the must."

Should the stalks be crushed, or not? This is a disputed question. Mulder says:—"That sometimes the stalks are considered indispensable to increase the quantity of tannic acid in the wine." Chaptal says:—"The stalk is generally admitted to act as follows, viz., to add conservative qualities to the wine, and to assist fermentation, but it gives roughness and hardness to the wine." Further, "Where the must is weak and insipid, as happens in moist districts, the stalk relieves the natural and consequent insipidity of the wine, and saves it turning." He quotes Gentil as having proved that the stalk gives force and regularity to the fermentation, and that therefore it is advantageous where as low and incomplete fermentation is expected. About Bordeaux they ferment with the stalk when the grape is little ripe, or has been frozen; but when it is very ripe they used the stalk to check too great sweetness and facilitate the fermentation.

The stalk is used in making white wines, experience having proved that without the stalk the wine is less spirituous and more liable to fatty degeneration.

The use of the stalk is also decided by the object of the winemaking, whether it be intended for the table or for distillation. By aiding the fermentation and developing the alcohol it is useful for distillation wine, and any harshness given by it is, in this case, immaterial. But for table wine, in which a combination of agreeable taste and exquisite bouquet is desired, we need select the grapes and regulate the use of the stalk, guarding the conditions with care. So says Chaptal.

But of all the French writers on the use of the stalk no one so lauds it as Machard. He says:—"It is always an advantage to the wine. It powerfully aids fermentation, more completely decomposing the must. It assists the development of aroma. It gives the must all the alcohol it can produce. It corrects acidity and adds body. It can but produce excellent results, unless by bad management it be left indefinitely in the liquid." These are Machard's words.

Any value in the stalk is due to the tannin it contains, and in discussing its use we must not forget that tannin exists also in the skin and in the pip of the grape, and that where these go into the fermenting-vat some tannin enters into the wine, though no stalk be crushed or fermented. Also, the proportion of tannin in the skin and pips of some kinds of grape is greater than in those of other kinds.

This tannin is essentially and vitally conservative to the wine, and through the wine it contributes to the health and vitality of those who drink it. To this tannin, says Machard:—"The excellent wines of Bordeaux, which are deficient in alcohol, owe their keeping qualities, and the property to travel in all latitudes." Whilst Mulder says:—"The preservation of wine is greatly due to the tannin, for it combines with leaven, which is thus prevented from decomposing." Now, supposing the wine not to have first possessed an ample degree of tannin, when fining time comes, if albumen and gelatine be used, these, since tannin combines with the leaven (an albuminous substance), would carry down some tannin, and consequently may injure the wine by diminishing its due proportion of tannin.

Chaptal adds:—"In the use of the stalk each winemaker must use his own discretion. Often in the same district are advocates for and against it, one making a more delicate, the other a stronger wine. In the South of France, where the wine is naturally generous, the stalk readily adds harshness to the wine, already by nature too strong, and hence there it is not generally used for table wine, but only for wine for distillation.

Arthaud of Bordeaux says:—"Sometimes the stalk is useful, at other times not so. And his rule is, "when the grapes consist of small berries, with thick skin and high colour, and their special flavour embodies much harshness, it will be useful to avoid the stalk; but when the grape is watery, large, and excessively ripe, if the skin is thin and little coloured, if its taste leaves in the mouth a sense of softness, dull and sweet, it will then be advantageous to place a part if not all of the stalk in the vat, thereby increasing the quantity of tartar and tannin essential to a good wine. Too much stalk will make the wine tart and harsh; too little leaves it flat and insipid."

Finally, I quote Guyot, from his recent work, vol. 3, p. 655:—"The vintage gathered should be passed through the crusher, over the press or near the press, if it is to make white wine; near the vat or over it if red wine is sought. In no case need the stalks be taken off if it is meant to make table wine. For white wine the stalk is inoffensive, since the must is at once extracted from the grapes, and for red wine of quality it ought never to remain in the vat more than eight days under the most unfavourable conditions, in which case the presence of the stalk is useful to give the wine part of its tonic virtues and solidity. In short vatting the stalk is good; in long vatting it may be *de trop*.

"The vintage for white wine ought to be crushed, and the must pressed out with as little delay as possible, and whilst fresh and cool, if you wish to avoid contracting yellow colour. Four pressings and four clippings of marc suffice to extract all the must, which should be mixed and distributed at once to their casks, which ought always to be the casks of sale or delivery. These casks should be ranged in warm cellars to complete their fermentation, with open bunghole, till December (the vintage being in September and October), when they should be shifted to the storing cellar.

"The vintage for red wine after its crushing ought to be placed in vats of 40 to 50 hectolitres (880 to 1,100 gallons). The vat filled to 10 to 12 inches of the top in one day, covered with a canvas or loose planks; then no other operation is needed in its interior until time for drawing off, unless it be a breaking down of the head and general mixture of the floating marc driven back into the wine to diffuse and solve the colour 12 hours before drawing off, which is the time necessary for the marc to remount and float on the wine."

Having disposed of the operation and material of crushing, our attention is directed to the placing the crushed juice or must in the vats or casks, where it is to ferment. The first consideration is the temperature of the must. The most favourable temperature, as stated by Chaptal, is 65° Fahrenheit. Lower than that the fermentation languishes; higher, it grows tumultuous.

Chaptal's rules are—

1st. That to equalize the temperature, the grapes of any one vat should be gathered in the shortest time.

2nd. That if the grapes for a given vat are gathered under atmospheres of very different temperatures, they should subsequently be exposed to the sun, or to one degree of warmth.

3rd. That the temperature of the must, as crushed, should be about 12 Reaumur (59° Fahrenheit).

4th. That the vat should be covered to retain an equal heat in the fermenting mass.

The second consideration is the limit of time within which the grapes of a given vat should be crushed. The size of the fermenting vat is involved in this question.

Arthaud (of Bordeaux) says:—"Large vats succeed better than little ones; nevertheless the size should never exceed that which can be filled in one day, or the fermentation will be broken and irregular," and he illustrates this by adding—"In the Medoc, as well as in most of the vine districts of France, there exists a classification of wines which is unexplained by any difference in soil, vine, or its exposure. This classification of wines is into 'chateaux, bourgeois, and paysans.' It is perfectly legitimate, and results from different methods of fermentation. At the chateaux a great number of vintagers are employed, so that the vats are filled in one day; whilst the smaller and poorer proprietors, economical of paid labour, and accomplishing their vintages by means of their own family, or chiefly so, fill their vats with too prolonged gatherings, and the fermentation commenced is subjected to repeated checks, which is a great evil. Also these small proprietors use small vats, where the produce of fermentation is inferior to that of large vats. A large vat in movement is less susceptible of atmospheric variations, which relax or overexcite the work of fermentation. Such are the causes of these different wines."

Maupin says:—"The vat should be filled within 20 hours." His reason is that "too long a time induces the grave disturbance of successive fermentations which result in mixed wines, some being more fermented than others;" also, "the simultaneous fermentation of the whole mass in any one vat is the most perfect, gives the best wine, the wine the most vinous. The fermentation is not good unless it be prompt."

Guyot says:—"A vat should be filled in one day in order that the fermentation be simultaneous. The interval of a night often allows fermentation to commence, and the after addition of fresh must injuriously interrupts the progress of the fermentation."

Eugène Ray, 1862, says:—"Each vat should be filled within 24 hours, so that the fermentation once commenced receives no check." And he adds:—"In filling the vat, the more solid skins and stalks will heap at the point of fall, leaving the more fluid juice surrounding this as a centre. These several ingredients in the mass should be stirred together so as to make the contents of the vat as homogeneous as possible."

Fermentation having commenced, what are the rules for its regulation? For, says Ray, if the winemaker seeks to produce a wine of clean task, agreeable flavour, and which has lost nothing of its aroma and spirit, he cannot attach too much importance to his method of vatting.

The external air should be kept from contact with the fermenting mass, vent only being provided for the escape of the carbonic acid gas. And the temperature of the fermenting-room should be guarded as much as possible from fluctuations, such as result by exposure to the freshness of the evening, night, or morning air. A regulated heat of from 66° to 77° Fahrenheit is considered the most favourable.

The colour and character of the wine will be greatly influenced by the temperature and promptitude of the fermentation. On this Guyot, 1868, remarks:—"That, contrary to received opinion of the maceration of long fermentation being requisite to give deep colour, white sweet grapes added to red ones greatly aid in decomposing the colour, especially if given to rapid fermentation. In the Gaude wine the white clairette grows with the 'pancé and tronquiere,' red grapes of Rendu;" "and," Guyot concludes—"1st. That it is the sugar, it is the quick and warm fermentation that dissolves the colour, not the maceration." He thinks a fifth of the grapes crushed for red wine should be rich white grapes without perfume. "2nd. That the degree of heat in the grape at the moment of vatting singularly influences the force and rapidity of fermentation, and consequently the extraction of the colour. It is beyond a doubt that the grapes of the same vines gathered in the cool morning and vatted will take eight or 10 days to ferment, whilst the same gathered in the heat of the day, and then vatted, will finish their fermentation in two or three days. 3rd. That the solidity of wines is improved by the promptness of fermentation thus obtained, and hence they keep better."

When the must is composed of sugar and leaven duly proportioned, and the temperature is favourable, the chief claims for artificial aid will be two—first, to frequently break down the head of froth, and stir it well into the mass beneath it; and secondly, to draw off or unvat at the proper moment.

According to Chaptal, this breaking down the head and stirring produce many good effects by rendering the fermentation equal at all points—by preventing the head attracting acidity from contact of the air, and by precipitating the froth, and mixing it with the subjacent matters which stimulate the fermentation, and accelerate its completion. The practice, he says, cannot be too highly recommended, especially where large masses are fermenting.

This rule appears to apply to wine generally fermented in vats, that is red wines; but Lamotte, who upholds the system, remarks that in making very delicate white wines, great care it taken to let the froth, or, as he calls it, superficial ferment, flow away from the cask; for when the cask is not filled, so that this froth can run out, the wine is never so clean tasted nor so free from bitter as when the froth is got quit of.

The reasons why beating down the head of the ferment in the vat conduces to a more uniform and prompt fermentation find illustration in the following statement of Lamotte, showing that well stirring up the whole contents of the vat proportions both heat and matter duly throughout. He says:—"The movement of fermentation gives two kinds of ferment, namely, the superficial or froth which floats, and another which sinks and forms the lees. Viewed by the microscope, the forms of these ferments are the same; but those of the lees are described as the older globules of the must, whilst the surface ones are younger and more active; but these eventually also sink to the lees."

The signs of incipient fermentation appear by centres of action irregularly placed in the midst of the marc—the decompositions propagate themselves spherically around these centres—the maximum of action is observable on the reunion of these groups in movement, and the heat increases relatively to action. All this time the must taken from the sides of the vat in the head shows more of density and less heat than the must taken from the centre of the head, often to the difference of 6° centigrade (= 43° about Fahrenheit).

The tumultuous fermentation, which rarely lasts more than 24 hours, is the extreme limit of action of the floating ferment. It is accompanied by abundant frothing. To this tumultuous fermentation succeeds a slow one, arising from the deposited lees.

It would appear, then, that unbroken down and unstirred, very different degrees of heat and of densities and of activity of ferment exist in various parts of the fermenting-vat, producing hence anything but that uniformity and simultaneity of fermentation alleged to be so greatly conducive to good wine. Also, on the other hand, when the fermentation is conducted in a vat, and the head forms and rests unbroken there, the risk arises of its becoming infected by injurious atmospheric influences, giving birth to organisms of a vegetable nature, the seeds of mischief in the wine. Hence, where through delay of breaking down the head with sufficient frequency infection threatens, he recommends that before drawing off the wine the chapeau or head should be removed from it to the depth of four inches or more, and that the wine run off should not be mixed with the pressings, so as to avoid injury.

On breaking down the head, Guyot, 1868, says:—"In Burgundy they decide by the saccharometer. At Corton, for example, they first break down when the saccharometer yet indicates a degree of sugar. The second breaking down is made 24 hours afterwards, and 12 hours after that they unvat. At Pommard the two breakings-down are also 24 hours apart, and drawing-off 12 hours subsequently. On all sides they vat with floating froth, and draw off when the wine is warm and troubled, finishing the fermentation in casks, new or perfectly clean, in a warm cellar."

How Long Should Vatting Last?

If in seeking a reply we blindly follow the doings of others, we soon end in a maze of doubt. All times are quoted—from 20 hours to 40 days. M. Marès alone cites 24 to 48 hours at Frontignac, three or four days in Gard, eight to ten days at Ampins, 15 to 18 days at Chateauneuf-du-Pape, 20 days in small and 30 to 40 days in large vats at Roussillon.

We must forsake following reputed practices, and trust to principles of action, bearing in view the object of fermentation, be it for light wine with bouquet, full-bodied wine with spirit, or spirit alone. In South Australia we do not cultivate vines for brandy, only for wines, therefore our object will be limited to either light or full-bodied wines. The light are definitely table wines; the full-bodied may be for table, or for commerce which buys to blend with lighter wines for body and colour.

To this question Chaptal replies :—"The length of vatting must be regulated by the nature of the grape and the qualities sought in the wine. The Burgundy grape cannot be treated as the grapes of the Languedoc. The merit of the one is bouquet, which long fermentation would dissipate ; the merit of the other is the quantity of alcohol, to secure all which fermentation should be complete."

Eugène Ray says :—"The good qualities of a wine and its future life may be compromised by a badly-managed vatting, as much as these may be secured by a vatting well managed. How many wines are deteriorated by a too long sojourn in the vat? Excessive vatting denaturalizes the colour of wine, dissipates its perfume, its strength, indeed all its good qualities —attacking its entire organization."

M. Marès says :—"The duration of vatting is short for table wine, and long for the wines of trade destined for blending. For the red Frontignac it is 24 hours, whilst in some localities of Aude it is 40 days. Rolland de Blumac wishes, for table wine, no longer vatting than suffices to colour it. In the Gard, at Saint Gilles, if they want to make rose-coloured wines, they are content to vat 24 to 30 hours only." Clement Prieur says a too short vatting will give an agreeable wine, but little suited for commerce, whilst one prolonged to maceration will cause hardness and loss of bouquet and spirit. At the same time he states that the rosy or claret wines are obtained from a fermentation of 24 to 48 hours only. They age promptly, are of delicate bouquet, light and full of flavour, and sought after by gourmands and connoisseurs. But beyond the kind of wine arrived at, the period for vatting is subject to the conditions of the elements engaged in the fermentation. The vatting should be longer or shorter as the must is more or less sugary and uniform, the temperature more or less warm and even, and the mass of the vat more or less voluminous. For example, Clement Prieur says :—"When the must is watery and the sugar weak relatively to the ferment, the action of the latter is quick and the wine soon made ; but when a warm season gives much sugar and little water, more time in fermentation is needed to convert sugar into alcohol."

The basis for calculating how long a must will take to enter on and effect its fermentation is one of speculative rather than real importance. The vital question is to decide when it has fermented sufficiently ; in other words, when to draw off the wine. If the right moment be passed the wine loses by delay.

Here many rules are laid down :—

Thus, Maupin says (1780) it was the rule to draw off 24 hours after the depression or defacement of the marc ; but he considers, in warm years, 12 or 18 hours is better.

Marchard advises drawing off at that stage when the taste of sugar beginning to disappear gives place to a vinous flavour.

Pellicot says careful growers in Beaujolais draw off at the moment when the hissing sound of fermentation ceases to be heard.

Vergnotte-Lamotte says in Burgundy they unvat when the density of the wine is near that of water, and that, as a general theory, this is the rule to follow. Of the test by density, Chaptal admits the saccharometer to be a useful instrument, as determining the degree of attenuation attained, but does not rely on it solely, adding, "in general the fermentation is finished when the pèse liqueur of Beaume, which marked from 10° to 15°, is down to one under zero ; that is, from 1075 to 1110 to 96° specific gravity."

Guillory (on the Red Wines of Marne et Loire) says:—"Most commonly the wine is drawn off when the head is depressed, the liquid cooled, and the noise has ceased; but that now-a-days (1861) it is well understood that the quality of the wine gains by unvatting so soon as the head begins to sink, and the consequent deficiency of colour is made good by the after addition of press wine."

Guyot, in his first publication on Winemaking, gave us this rule for unvatting:—"When the ear applied to the vat hears no more bubbling, when the hand plunged into the marc feels no more heat, the wine is made and perfect, whatever be the colour." But, in 1868, he advises to draw off when the wine is yet "troubled and warm."

Clement Prieur says:—"The precise moment for unvatting is when the head is falling, the bubbling having ceased, and the heat of the marc very sensibly diminished. If a sample of the liquid be drawn off it is not yet clear and has some heat. Wines too long fermented are charged with salts and colour, which subsequent rackings and finings are often powerless to remove."

Eugène Ray says :—"It would be difficult to fix the exact moment for unvatting every year; but generally it has arrived when the sugary taste is being succeeded by a vinous one, and when the colour is such as should result from the maturity of the grape. Commonly these conditions are fulfilled when, having reached the height of fermentation, the must begins to sink. This maximum of fermentation and the subsequent incipient sinking may happen three or four days after the vat has been filled, or it may not arrive for ten or twelve days, being controlled by the constitution of the must and the temperature. Therefore the vat must be carefully watched, the fermenting liquid tasted and tested, in order to judge of the degree of decomposition of the sugar, and to unvat whilst there remains sugar enough to be clearly recognisable. From the moment when the tumultuous fermentation is over—the greater part of the sugar having been converted into alcohol—the wine has no more good to acquire from the vat. On the contrary, its constitution will be injuriously affected by longer contact with the marc."

Chaptal says :—"We must recur to principles for any fixed base of action. The object of fermentation is to decompose the sugar. Its activity and length then have relationship to the quantity of sugar in the must.

"A principle inseparable from fermentation is the produce of heat and carbonic acid gas. The heat tends to volatilize and dissipate the perfume or bouquet; the gas, if retained, can make the wine agreeably piquant. Thus weak wines, but agreeably perfumed, require but little fermentation, and those white wines whose chief quality should be effervescent need scarcely stay in the vat.

"Alcohol is the immediate product of the decomposed sugar; hence, when we vat grapes rich in sugar, as are those of the South, the fermentation should be active and prolonged, because these wines, especially if intended for distillation, ought to produce all the alcohol the sugar can yield. If their fermentation be slow and weak the wine remains liqueurous, and becomes agreeable only after long sojourn in the cask.

"In general, grapes rich in sugar should ferment long, but those with little sugar not so long, for from the moment all the sugar is decomposed any ferment left undecomposed or not neutralized acts and produces acid.

"Generally I have observed that with the men most noted for making wine the moment selected for unvatting is when the sugary taste disappears and the vinous flavour is developed.'

CONCLUSIONS, BY CHAPTAL.

1. The must should be vatted as short a time as it contains little sugar. Light wines of Burgundy remain but 20 to 30 hours in vat, whilst those of Volney, Tommard, &c., are many days. These last keep long and sell dear, but have a little hardness, from which the light wines are exempt.

2. The must should be vatted a short time if the gas is to be retained for an effervescent wine—24 hours, or without any sojourn there.

3. The must should be vatted a less time as less colour is wished in the wine. This rule is only applicable to musts fermented on their marc.

4. The must should be vatted a less time as the heat is high and the mass for fermentation large. Then the activity is a substitute for length of vatting.

5. The must should be vatted a less time according as bouquet in the wine is desired. The wine of long vatting gains a slight harshness or hardness.

6. Vatting, on the other hand, should be long in proportion as the sugar is abundant and the must thick ; and it should be long where the object is wine for distillation.

7. The fermentation will be slower to commence and more prolonged as the temperature has been cool at vintage time.

On the due moment for unvatting, however, I have held over to the last the most recent record, 1868, of that veteran in œnology, Dr. Jules Guyot, because his statements now come to us with all the force and freshness which a long personal study of the subject as practised in all the best wine districts of France up to the present day, by one so well able to observe and report, could supply, and I here beg to thank Mr. Page, of Mitcham, for a view of Guyot's book.

In extracting the record I risk the blame of a discursive reference, for the unvatting is so involved in valuable sketches of fermentation as a whole that I have not the heart to reject the general reference in attempting to show his view of the one branch of it. Guyot says:—"If you have not gathered your grapes in the cold morning, if you have left them exposed to the sun, in 24 or 48 hours your vat will enter on boiling. Leave it to boil; be content to listen daily. When you hear the loud noise of bubbling diminish, place your ear to the vat oftener—every two hours; and from the moment when you have assured yourself that the noise has sensibly diminished, and that you see the marc sinking, quickly draw off from your vat into good casks—new, or well cleaned and sulphured. As quickly as possible as the wine draws off carry the marc under the press. Fill all the casks with equal portions of the pressed wine, for it possesses in a high degree the conservative principles of the wine, and these are indispensable. Then put a vineleaf or a little stone on the bunghole, and leave it eight or ten days, till the wine ceases to work. Then fill the cask, place the bung in easily, and every eight days fill up. After one month firm the bung tightly, and you will have the best wine. Let the chief boiling of the vat diminish and subside after four or five days only—all the better—the wine

will be excellent. If that is delayed to the sixth or seventh day it will be less beautiful and good. If that is further delayed the wine will be less good still; but the true end of the vatting is the fall of the great fermentation. After that all contact of the wine with the marc weakens it, for the marc seizes its spirit. As to the stalk, when the vatting is good and short, it cannot do harm, and the head of the ferment never contracts acid."

Dr. Guyot (1868) further adds:—"It is worthy of note that the more reputation the wine has the shorter the vatting. Thus, the finest wines of Thorins vat 18 hours only; those of Chapelle de Quinchay 36 to 40 hours, &c. One could tariff their value by the length of vatting."

"A slow and prolonged fermentation is a real evil, imposed sometimes on a cold and wet season, when the grapes are unripe. But to procure the best possible wine, fermentation should be quick and vigorous, for it is the very warm and rapid fermentation (as a rule, say three to six days), which gives the best colour, the most spirit, and the best wine."

As soon as the marc can be drawn from the vat press it. Give four pressings. The wine from the first three pressings goes to the drawn wine in equal proportions. The fourth or last pressing is put apart.

The wine finishes its fermentation in the cask. That is the necessary complement of every rapid fermentation. This process should take place in an atmosphere warmer than the ordinary cellar, and when it is completed the wine should go to the ordinary cellar.

During secondary fermentation the casks should be daily filled up, so that the froth may overflow. The propriety of arranging for the overflow of the froth has been greatly discussed, and is yet undetermined; but it is proved that the wine which completes its fermentation in the cask is more generous, more brilliant, more limpid, and full of bouquet than that which completes its fermentation in the vat.

"The means of making the best red wines are so simple that one is never persuaded to employ them. Complete maturity and identity of grapes, rapid filling of the vat, unvatting after three or five days, mixing the drawn with the pressed wine, wine drawn troubled and warm, finishing the operation in the cask, deposit in sweet cellar, racking in December or January (Australia—June or July), that no one would believe that this is the sole practice of the Côte D'or, of the Medoc, of the Maconnais, of Saint-Emilion, &c. No one will believe that the longer the wine remains in the vat the more it is weakened; the more the marc takes of its spirit the more its colour fades and the less it will keep, because its substance is consumed and rendered flat by the maceration of the marc in the juice, all which is absolutely and scientifically true; and I can say no more of what is needed to secure good wine, because I know nothing more nor better.

"As to the making of white wines, it is yet more simple; it is the sun that should make them with one and the same vine. Take the muscat dorés alone if you wish to make muscat wine; take the furmint alone if you wish Tokay; and the same for all white wines. Ordinary white wines ought to be made of grapes thoroughly ripe, and if for liqueur wines extra ripe. Nothing is more simple than the making of them, namely—Gather the grapes well ripe, submit them to the press, after having crushed them; put the must in new casks left in the surrounding temperature of an open cellar, or under a shed, up to winter, for common white wines, but over some years for liqueur wines. Rack off in December or January (Australia—June or July), after having fined them with four whites of egg, five grammes of tartaric acid, and six grammes of tannin per hectolitre (22 gallons); fill up carefully, and keep them well bunged and in clean cellars. All that is required to make good common white wines and liqueurs are the grapes, the sun, and very simple care."

Then, in a final summary, Guyot proceeds:—"If the general temperature be 18° (64° Fahrenheit), it will not be necessary to heat the crushing-room, but the grape should have a temperature of fully 15° to 20° (59° to 68° Fahrenheit) degrees of heat on entering the vat. In which case 24 hours will not pass without fermentation announcing itself by a noise resembling rain, perceptible on placing the ear to the sides of the vat. In 48 or 72 hours it will have grown to a noise resembling that of a pot of cabbage in full boiling; this is the great boiling. Soon the noise moderates, and the marc begins to subside. This is the moment to break down the marc into the wine and wash it there, so to speak, in order to distribute the colour which has dissolved in the marc in proportion to the heat of formentation. Twelve hours suffice for the marc to re-float. It is the moment to draw off the wine. Fill the casks in a warm place to about three-fourths, the remaining fourth to be reserved for the pressed wine.

"So soon as the wine, warm and turbid, has been drawn from the vat, the marc undergoes four pressings, of which the first three go to the drawn-off wine, in equal proportions, for they contain more sugar, more tannin, and more salts, necessary to complement the qualities of the wine. If the fermentation in the vat has been accomplished in less than seven days, the wines of the press do not contain other than useful elements for the wine.

The wine completes its fermentation in the cask with open bunghole. The pips, the skins, and the excess of tartar come off for several days, and the daily filling up is done to effect this purification. It is thus the best red wines are made—best in colour, in brilliancy, the most generous—with open vat—marc floating, and drawing off when warm and turbid, to be perfectioned in the cask.

"The slower and longer the fermentation, the less generous, less coloured, less durable are the wines. All the time, beyond the height of tumultuous fermentation or the great boiling is a time of maceration. The more the maceration is prolonged, the more the wine loses spirit and colour, becomes heavy, and has lost life."

In all the vineyards in the Haute-Marne, l'Aube, Touraine, Indre, and 20 other departments, where they make white wines, rose wines, and red wines macerated, with the same kind of grapes and at the same time, the white wines are bright, light, and generous; the rosy wines, which are the wines made with 12 to 24 hours' vatting, are remarkably good, healthful, and capable of indefinite preservation; whilst the red wines macerated are heavy, dull, flat, and mostly cannot exist long without turning.

If we take a view of all the delicate and noted red wines, we see that all, or at least all with very few exceptions, are the products of fermentation not exceeding eight days; whilst all the wines of commerce, of mixing and blending, are the products of maceration or of a fermentation prolonged in the vat to two or four weeks and more. All these wines are bought by the artificial makers of wine, and are, besides, most frequently made for them at their command.

Besides, experience and deep study show—1st. That the more a wine has fermented on its marc, the less it has of spirit. 2nd. That the colouring of wine is not in proportion to length of vatting, but only in degree of the heat of fermentation. 3rd. That wine keeps less in proportion as it has been macerated a longer or shorter time. This is proved in all France by the respective durations of wines non-vatted (or white), demi-vatted (or rose), too much vatted (or dark red wines).

We have thus pursued the fermentation of grapejuice from its being crushed to its product—wine.

Of the sugar and leaven, and the tartaric acid and tannin—of which we saw the grape-juice was composed—if the fermentation has been perfect the sugar and leaven have totally disappeared. The leaven died out in decomposing the sugar, their joint elements producing 44 parts alcohol and 46 parts carbonic acid to every 100 parts of sugar. This carbonic acid has passed into the air, and the alcohol remains in the wine, which is a dry wine.

If the fermentation be imperfect yet sound, some sugar remains, but the leaven is gone, and the wine is a sweet or liqueur wine. But be the sugar and leaven both totally gone, or the leaven only, the other ingredients of the grape—namely, the tartaric acid and the tannin—remain; and their presence is essential to the fulness, health, durability, and agreeableness of the wine. Without them the wine would not develop its merits. For, whilst tannin keeps guard against hostile agencies threatening injury, the tartaric acid combines with the alcohol and produces bouquet; and, aided by the chemical action of other substances sprung from the inorganic matter of the grape, or formed during the process of fermentation—substances named by chemists salts of lime, potash, magnesia, &c.—they concur in establishing that special body, bouquet, and flavour of wine, for which the particular kind of grape, its soil, its climate, its culture, and other incidents affecting its life, have supplied the germs. The bitter and astringent qualities of tannin both help to preserve the wine and to make it more tonic. Whilst on tartaric acid, in a fixed relation to the alcohol more than on any other constituent of the wine, the goodness of wine is said to depend. Griffin, in his "Chemical Tests of Wine," says that "with a tartaric acidity of 450 grains per gallon and from 20 to 25 times its weight in alcohol, you have a good wine." That "the superior Rhine and French wines have alcohol for from 21 to 25 times their weight of this acid;" that "all good wines have from 300 to 450 grains of tartaric acid per gallon," whilst "the wine with less than 300 grains is flat, and with over 450 grains is too sour to be agreeable;" and that to the abundant presence of tartaric acid in the grape-juice is attributed the cause why better wine can be made from the grape than from any other fruit. Many writers confirm this statement.

In conclusion, I beg pardon for the too diffusive character of this paper. It has indulged in repetitions of detail, but these have been expressly given to prove concurrence of opinions of various authorities and to strengthen illustration. It was collated for self-instruction, but having been promoted to be read before you, I have been led, or misled, by the impression that what I have regarded as useful to myself might be useful to others.

"Beckwith" says that "cheap wholesome and natural wines are priceless desiderata to a country like England." If true of England, this is also true of other countries equally unable to grow wine for themselves. And, if so, the material exists in the grape grown in South Australia, by developing which we may both benefit mankind and enrich ourselves.

To be prophetic, the time will come when Australia will contribute wine as well as meat to the health and comfort of the poor of England.

William Kyffin Thomas, Printer, Adelaide.

PAPER READ BY HIS HONOR SIR R. D. HANSON, ON TUESDAY EVENING, APRIL 9, 1872.

SUBJECT—"THE THEORY OF EVOLUTION."

Gentlemen—When I was requested to read a paper before you, I had for a moment some doubts whether I should comply with the request, for I knew that I could not hope to prepare anything which had a practical bearing upon the industries of the colony, and I had more than once heard at your meetings congratulations that mere speculative questions had been abandoned for those which had an immediate practical object. But I reflected that if that were the sort of paper required I should hardly have been the person invited to read it, and that therefore the invitation implied an approval of the kind of topic that I was likely to select; and as I had for some time past been thinking a good deal in a desultory manner on the theory of Evolution, chiefly in connection with the writings of Mr. Darwin, I conceived that I might make that the subject of my contribution, in the hope that it would both enable me to put my own views into a clearer and more systematic form, and would not be without interest to you.

The theory of Evolution, as you are no doubt aware, implies that all the higher forms of life up to and including man are the developed descendants of some lowly primæval forms. Most theories upon the subject have assumed that the changes by means of which the original structureless jelly, or whatever else might be the first life-form, has been evolved into the myriads of species by which the earth is now peopled, have been for the most part gradual; one form passing by well-nigh imperceptible gradations into another, as circumstances favoured or induced the change. Mr. Darwin, starting from the assumption of the occurrence of such small changes in individual organisms of every species, shows how some of these changes will almost inevitably give to the individuals manifesting them some advantage over their fellows, which under favouring circumstances will enable them to survive and leave offspring when others perish. He then assumes, on the known principle that the peculiarities of the parents tend to be inherited by their offspring, that these advantageous changes will in some cases be inherited, and that some of the individuals who inherit them will undergo yet further advantageous modifications in the same direction, which again will be inherited and modified; and that this compound process of transmission and change is sufficient to account for the existence of all orders of animals, including man himself, provided only that time enough is given during which it may operate. I have thus stated the theory in its simplest elements, and so as almost to leave out of sight that which is its main feature as propounded by its author, namely, the intense struggle for existence among individuals and species which necessarily results from the indefinite capacity of reproduction in all organisms as compared with the limited space for their occupation, and which it is argued must necessarily result, on the whole and in the long run, in the preservation and perpetuation of those whose organization gives them any advantage over their fellows.

The peculiarity of this theory distinguishing it from all previous theories, and to which it owes its wide acceptance, is that it rests upon facts patent to every observer, and that it accounts for many phenomena which formerly were inexplicable, or only to be explained by a reference to an arbitrary process on the part of the Creator. There can be no doubt that throughout nature all organisms, whether animal or vegetable, tend to vary, and that these individual variations are often transmitted; and it is equally certain that, to take the most obvious case, only an inconsiderable proportion of the seeds produced by any tree in the course of its existence could grow up and continue to propagate the race without starving out other plants, and ultimately starving out themselves. And the same is the case with regard to the offspring of animals. So that every place in the earth is filled, and room for new comers can for the most part only be found by the displacement of some previous occupant. In a struggle so intense and unintermitting it is easy to conceive that trifling advantages may enable a particular individual to maintain his ground when others succumb, and thus to leave a progeny when others failed to do so; and those of his descendants who inherited the peculiarities to which he owed his preservation, possibly intensified by further variations in the same direction, might in like manner be expected to survive in greater numbers, and to leave a more numerous progeny. Nor is it easy to assign a limit to the possible changes that might thus be produced. It is also the fact that there is among existing organisms an approach to an unbroken series from the lowest animalcule to the highest ape, and that this latter is connected by unmistakable affinities with man, and that a similar series can be imperfectly traced from many of the earliest fossil organisms to those which exist at the present day; both of which facts suggest (though of course they are very far from proving) that the connection between the lower and the more perfect forms is that of descent. And further there are resemblances of the general structure even in the most widely remote families of plants and animals which also suggest a relationship between them. At the same time the theory offers a plausible explanation of such circumstances as the embryonic resemblances among different orders of animals, the appearance of abortive or rudimentary organs, the uniformity of type that pervades all vertebrate animals, the succession of similar forms in different regions of the world—marsupials in Australia, edentates in South America—the general resemblance of animals in islands to the continents with which they are most nearly connected, and other similar facts. And I think that no one who carefully investigates the subject can deny that natural selection has played an important part in the origination and preservation of species, however much he may be disinclined to accept Mr. Darwin's view that it has been the only cause.

It is obvious, however, that the theory of the origin of species by means of natural selection takes up the question at its second stage, namely the manner in which variations of structure are turned to account, and how those which are advantageous are preserved and transmitted and accumulated, and does not deal in any way with the preliminary enquiry to what cause these variations are owing. That such variations occur is accepted for the purpose of the enquiry as an ultimate fact, and all that is done is to suggest circumstances which are favourable on the one hand to the variability, and on the other to the permanence of species. Even therefore if the theory did all that it is credited with by its author—and in spite of all difficulties I am inclined to the opinion that it does—there would still remain the question to what causes these variations were due, and no theory could be regarded as complete which did not in some manner answer that question.

In attempting to say something upon this subject I must disclaim any pretension to offer anything that can be regarded as a solution of this question; my only purport is to suggest a few considerations which have occurred to myself, chiefly with a view to indicate in what direction a solution might be sought, and what are the conditions of the problem; and even thus regarded I cannot but feel that they are crude and imperfect. Still as what has occurred to one thinker may not have occurred to others occupied with the same topic, at least in the same form, and as no one can tell till tried by the test of other minds whether any worth attaches to his speculations, I have decided to proceed, if only for the purpose of showing in what manner the question appears to myself.

The first thing to be accounted for by any theory of Evolution is the uniformity of type which, as I have said, pervades all animated nature. This is, no doubt, partially explained by the theory which makes all existing organisms the descendants of some one primæval organism, and the uniformity the result of inheritance. But such a theory has no foundation upon any hypothesis as to the mode in which life originated, whether by special acts of creation or by development under conditions. If we accept the former hypothesis then the doctrine of Evolution has no place, since what has once occurred may have occurred again and again, and the origin of species is more simply and naturally accounted for by repeated special creations. And if we accept the hypothesis that life is or was originated under certain conditions, then we have no ground to suppose that these conditions were confined to one point in space

and time. Rather must we assume that they existed at innumerable points in the primæval ocean and during long epochs. But then every point at which life was thus originated would be a centre from which life would radiate and organisms be diffused, so that there would be as many separate stems of organic growth and succession as there were points of life-origination. And on the theory of natural selection no reason can be given why all of these various stems should be organized upon the same type, and why they should pass, in their development, into higher forms through similar or analogous variations. It cannot be said that the conditions in which all these various original organisms were placed at first, or those to which their descendants have been subjected, have been so uniform as to generate this uniformity; for in truth the conditions are so different in many cases as to create, so to speak, a difficulty in maintaining it and have allowed, or perhaps we should say compelled, the almost infinite diversity of organization that exists and has existed on the earth. And if we admit that we are unable to say upon what other types animal and vegetable life might have been moulded, we must also confess that the same ignorance prevents us from concluding that the existing type is the only or even the best possible type, or from seeing anything in the medium in which life is manifested that necessitates the adoption of this as the sole type. The cause, whatever it may be, must it would seem be sought in some other direction, and is not to be found in the conditions in which organic life has been placed.

There is one explanation that has been offered of this uniformity to which I may refer in passing, viz., that it is a result of what can only be termed a voluntary limitation imposed upon Himself by the Creator, who, it assumes, has chosen to confine Himself to one plan in forming all creatures, and has shown His skill in the manner in which He has adapted this plan to all the varying conditions of being. But this, apart from all other objections, is only to give a theological expression to an observed fact, and does not afford any help towards the solution of the question. If it closes enquiry into the reason why this uniformity exists, by accepting the will of the Creator that it should be so as an ultimate fact beyond which it is impossible to penetrate, yet it leaves the mode in which the result is worked out entirely unexplained, and that is the question with which science is concerned. It is really no more than an expression of contented acquiescence in our inability to solve the problem which this aspect of nature presents. Admitting our present ignorance, it closes the door against those investigations by means of which we might pass from ignorance to knowledge. We may indeed admit, and I should be the first to do so, that everything we see around us, the most intelligible as well as the most obscure, is a result of the Divine fiat, and therefore a part of the Divine plan, but our uniform experience has shown us that this plan is not arbitrary nor its results capricious or causeless. Whatever exists is a link in the endless chain of being, connected with the past, upon which it depends, and with the future which, in part, depends on it; nothing is uncaused and nothing is irregular. And the task of science is to trace the order of phenomena and to detect those antecedent phenomena of which they are the result. And the more completely this is done the more signally we may expect will the power and the wisdom of the Creator be displayed.

I have referred to this topic because in spite of all that has been said on the subject there is still an uneasy feeling in the minds of many whenever the doctrine of Evolution is mentioned, and especially when there is a hint of the possibility of what has been termed "abogenesis," that is, the origination of life in lifeless matter without the presence of some vital organism—seed, or germ—to account for it, as though this showed that it was possible to dispense with a Creator. But this doctrine or theory, if true, would but show that matter had one other property in addition to the other marvellous properties which we know it to possess, and therefore could affect the faith of those only who thought that matter was self-originated and self-endowed. To those, who believe that there is a Creator and Ruler of the universe it surely can be no reason to lessen their wonder and reverence in regarding Him to find that the material of which He has formed the worlds possesses one additional property higher and more wonderful than any which had been previously assigned to it.

With regard to this question of biogensis or abogenesis—that is to say whether life can originate in non-vital matter without being derived from previous life, or whether in all cases it must be so derived—it seems to me that it would be difficult to admit the doctrine of Evolution in any form without assuming, or imagining, that in the first instance, at least, life must have originated out of lifeless matter; and if so originated once it would seem there can be no reason in the nature of things why it should not continue to originate in the same manner. It is true that we may expect the instances of such origination to be now comparatively or perhaps absolutely rare, since it can seldom happen that matter is in a condition to become vitalized without the presence of some seed or germ ready to appropriate it. But I must confess that I attach no weight whatever to the experiments by which the impossibility of its so originating at the present time has been supposed to be demonstrated. Those experiments appear to have conclusively shown that it is possible to destroy or suspend the conditions under which matter capable of becoming organized will pass from the non-vital to the vital state, and this we might believe without any very strict proof. But it seems to me to be an unwarranted inference to assume from this that under no circumstances non-vital matter can become vital unless some germ is present. In the vast laboratory of nature, in the depths or shallows of the ocean, on the margins of rivers and lakes, in the steaming recesses of tropical forests, in alluvial plains, under the vivifying beams of the tropic sun, there must be many conditions and combinations of which we have no experience, and which it is impossible to imitate in our experiments, and it appears to me altogether illogical to argue that life could not originate in the strictest sense under some of these conditions because we can prevent its origination under certain limited conditions in our test bottles. Certainly the change from non vital to vital matter, however great it may appear, if regarded as the commencement of a series which may terminate in man is not, to our observation, very great in itself. The difficulty appears rather to be to determine the line between the two classes. It is not always easy to distinguish, say, between the Brownian motions, which are allowed to be due to the properties of inorganic matter, and those motions which are the result of organization. My own observations would lead me to doubt whether there was any difference that might not be produced by the different mode of arrangement of the particles of which the moving body is composed; and I know of no ground for saying either that the mode of arrangement of the particles of these almost structureless bodies may not result from the properties of the elementary substances of which they are composed when these are brought into contact, or that they can only be brought into contact by means of the presence of some germ or vitalized matter. But this is a point which, it appears to me, must be left to be decided upon general principles, since proof of the absolute origination of life which shall convince gainsayers is scarcely to be expected considering the innumerable modes which may be suggested to account for the existence of germs in the fluid selected for the experiment, and disproof is impossible. And upon general principles it would seem that the probable and almost the necessary conclusion is that life does and will originate under given conditions; that just as crystals will form in a solution of salt, under certain circumstances, where no previous crystals existed, so organisms of the lowest and simplest grade will form where certain inorganic elements are present under given conditions of heat, moisture, motion or rest, and light or darkness; though we may not be able at present to determine what those conditions are; the greater variety of the constituent elements implying possibly a correspondingly greater complexity in the conditions.

It will be seen, however, that this reasoning only applies if we are to regard the manifestation of the phenomena whose totality we call life as a result of the properties of matter. If we are to regard the vital force as an independent entity added to matter under given circumstances, regulating and controlling properties that belong to it in its non-vital state, and imparting new properties, then it may be admitted that non-vital matter can only become vital when this entity is superadded, and that this can only be done through the instrumentality of previous life. But it would seem that it is impossible to maintain such an opinion, for we know the vital force only as a property of matter, and it is impossible to frame any definition of life unless as it is manifested in matter. And, besides, let anyone consider what is involved in this theory of the separate existence of the vital force and its transmission from parent to offspring. Take the case of a grain of wheat at the present time. The only vitalized part, that is the only part capable of transmitting the vital force, is the germ. From this germ, under favourable circumstances, more than twenty stems may spring, each of which may produce from thirty to forty grains. All of these may be sown and each of them may be equally productive; and this process might be repeated until the whole earth was covered, and on the hypothesis all this would be the actual result of the vital force contained in the original germ which has never been added to and which, in spite of its almost infinite diffusion, is as potent in every one of the last billions of grains as it was in the first one. Of course few persons—possibly at the present time no one—would carry his theory to this length, but this is only because they do not carry it out to its logical consequences. If any one did so then I believe he would find no alternative between adopting this conclusion and abandoning his theory. This reasoning does not, it will be seen, affect the views of those who regard the vital force as a property of matter under certain conditions, but who consider its derivation fron pre-existing life as one of these conditions. With them I only differ so far as to doubt whether the evidence authorizes us to conclude the impossibility of non-vital matter assuming those combinations and that arrangement of particles, and those molecular motions of which life is the result, or which are life, unless under the influence of vital or vitalized matter.

I have used the term vital force in this dis-

cussion because it is that which is commonly used to designate the cause of life, though it is not free from objection, since it has been generally so used as to imply its existence as a separate entity separate from matter though occasionally added to it. But I do not think that this need affect the employment of the term, any more than the old theories of heat and light, as separate entities, affect our present employment of those words. Their original meaning subsists with many, who look upon light in Milton's phrase, as the "offspring of heaven first-born," and upon heat as something which passes bodily from one substance to another; but that does not affect the scientific use of the words, or the scientific conception of the facts they express. And it seems to me that there is need of some distinctive word to indicate the distinctive form of force of which what we term life is the manifestation. It is true, as Professor Huxley says, that we do not employ the term "aquosity" to distinguish the cause, whatever it may be, that produces and maintains the properties of water. But surely the phenomena of life are sufficiently distinct from all other classes of phenomena to require a separate phrase by which to characterize the force to which they are due; and just as we use the word "life" itself to express the totality of these phenomena, so we may employ the term vital force or vitality to express the form of force of which they are the result. I do not, however conceive of this form of force as external to the phenomena, but as a part of them. It is involved in their manifestation and can scarcely be conceived of excepting in connection with them. Like every other force in the universe of which we can take cognizance, it is only manifested in and through matter. Nor can we, I imagine, regard it as of a different nature from the other natural forces, since it is strictly correlated with them, may be measured against them, and described in terms of equivalence with them. Its peculiar office, if I may use the term, appears to be to determine the position in the organism of the ultimate particles of which it is composed, just as the office of the force to which crystalization is due determines the position of the particles in the crystal. The properties of the substances of which the organism is composed are determined by the nature and arrangement of their ultimate particles, and the form and character of the organism depends upon the properties and arrangement of these substances, and both of these are determined by the vital force. They are not such as the particles would assume unless they became part of an organization, nor can we attribute them to the operation of any other form of force whether electricity or chemical affinity. Both of these, no doubt, play an important part in the various vital processes, that is, all the particles of the matter which enter into the composition of any organism retain the property of being electrically or chemically affected by other particles in the organism, or by other matter, but the motions to which the various successive forms assumed by the growing plant or animal are due, as well as the various arrangements for the transmission of life, cannot be regarded as either electrical or chemical. They must be referred to some other form of force which, judging from its results, the only mode in which we can judge of any force, must be, at least, as different from those I have mentioned as they are from each other.

In the transmission of life the form and character of any given organism are, as a rule, substantially identical with those of the parent, though there are seeming and perhaps real exceptions to this in the lower organisms; but, together with this substantial identity, there are always individual differences, so that the progeny of the same parents differ from each other and from their parents to a greater or less degree in almost every part of the organization, and the members of a species differ among each other yet more widely. To me, however, I confess it seems that the resemblance is far more wonderful than the differences. Looking at the manner in which organisms are developed, it is to me a matter of perpetual marvel that the departures from the type should be as few as they are, and should be kept within such narrow limits. Take the development of the fœtus of a mammal. There is a microscopic cell scarcely differing from any other nucleated cell, and the first process after it is brought into contact with the fertilizing element is simply the segmentation of its contents and the formation of new cells—nothing that can suggest even the form that will be developed. For some time the fœtus is little more than a shapeless mass, in which the experienced eye can indeed, after a time, detect the portions which will subsequently become developed into the head and trunk and limbs, but in itself bearing a much greater resemblance to the embryos of some lower forms of life than to the form which it will eventually assume. And remembering that the elements of which it is constructed, and by which it is nourished will, with equal readiness under other circumstances, assume any one of the myriad forms of animal life, for these elements are essentially the same throughout the whole animal kingdom, and that the form which the mature animal actually assumes is due to the influence of a cell, almost, and in some instances quite, invisible to the naked eye, and of the still more minute elements by which it is fertilized, I think that every one will admit that the wonder which I have described myself as feeling is fully justified. The phenomena of nutrition are wonderful enough; how, for instance, the same loaf eaten by a man and his wife and child and negro servant and dog should be transformed into the various shades of colour in eyes, hair, and skin, and should contribute to build up such widely different organizations! But here we can understand that the form which the substance of the loaf shall assume when assimilated is determined by the form of the organization that assimilates it, its various elements being abstracted from the blood into which it has been transformed, and assuming the position of the particles which they replace. This is wonderful, but it is to a certain extent explained by other phenomena, such, for instance, as those in which particles of silex assume the precise form of the woody fibre or animal tissue, which they replace in the process of petrifaction, so that the minutest details are faithfully reproduced and preserved. But in the case of the growth of the fœtus there is no pre-existing form in the cell bearing any resemblance to that which the particles entering into combination with it are to assume, so that the analogies of nutrition fail us here. Nor can it be said that the form is due to the influence of the mother, since after the fertilization of the ovum her function is only to supply the requisite nutriment, and this, though affecting the size and constitution of the progeny, has no influence whatever upon its type. If, for instance, the mother is a mare and the sire an ass then, in spite of the circumstance that all the materials for the growth of the fœtus have been supplied by the mother, the foal will be not a horse but a mule. And just as the milk of a mammal of any species will furnish nutriment for the young of any other species, so we may believe that the blood of any mammal would afford nutriment for the fœtus of any other species, supposing it were possible to transplant it from one to the other. Or take a seed, the changes of which come more within the scope of ordinary observation. It originates as a cell in the ovary of the flower, and when fertilized either by the direct contact of the pollen, as in one class of plants, or as is more generally the case, by the tubes which the pollen sends out when brought into contact with the pistil, a series of changes is originated which results in the development of the ovary into the fruit, and in the maturation of the seed itself. But in this case also the changes are nothing more than the assumption of these forms by the sap which the plant supplies, and this sap is only the form assumed by the nutrient particles which the roots have absorbed from the surrounding soil. As a general rule no ulterior changes occur until after the seed is detached from the parent tree and placed in a position which supplies the necessary conditions of growth. These conditions appear to be warmth, moisture, and sometimes darkness (though probably this last is only a consequence of the necessity for maintaining a temperature varying only within certain limits and for the retention of moisture), or in other words the existence of a certain intensity of those molecular motions which we call heat — the absence (possibly) of those molecular motions that we term light, and a certain mobility of parts resulting from the presence of water. Given these conditions, certain changes take place in the arrangement of the particles of the germ, which enable it to combine with or to assimilate any nutrient particles that may be in contact with it. But in order to this it is necessary that the soil which supplies these nutrient particles should be in a corresponding state of warmth and moisture, that is, should be the subject of the same molecular motions, and should possess the same mobility of parts, since otherwise its nutrient elements cannot combine with the germ. But when this is the case there is a reciprocal action between the soil and the germ which leads to the assimilation by the germ of certain particles from the soil, or looking at the phenomena from the other point of view, in certain particles of the soil uniting with the germ; for it is obvious that the assimilation or union is due as much to the properties of the combining or assimilated matter as to those of the germ. We say that the seed grows, and that is the apparent fact; but what really grows is the matter that has entered into combination with the germ, or if this expression should be objected to at least it must be admitted that the growth of the seed is not the result of any self-multiplication of its original particles, but of their union with other particles, and is due to the forces of these latter particles and not to those of the germ. For according to all analogy the forces inherent in the germ, whether of a plant or animal, are exhausted by use, and the particles of which it is composed pass, after a very brief interval, into a non-vitalized state. The function of the germ is not to confer force upon the particles which it assimilates, but to determine the direction in which their forces shall operate, and by consequence the form which they shall assume. The ultimate particles of the germ, as a result of its being subject to the conditions necessary to its growth, undergo certain determinate changes of arrangement, and the molecular motions which determine these arrangements are imparted to or rather taken up by the matter assimilated. And this process continues through the whole growth of the plant, whether for days or for centuries, the material which it absorbs undergoing certain definite changes determined by changes which have taken place and are still taking place in the absorbing tissue, which again are only the expression of certain motions in the elementary particles of the substances constituting the organization, communicated to the

particles of any fresh matter absorbed. In thus conceiving of the phenomena of growth, we bring them to a certain extent within the analogy of other familiar phenomena such as fermentation, infection, &c., where the introduction into a mixture containing the appropriate elements, or into a living organism of a minute particle in a certain condition, initiates a series of changes which are propagated from particle to particle through the whole, the arrangement of certain of the elements being altered so soon as they are brought into contact with another portion which is in process of undergoing the change. And indeed it is not without a certain rough analogy to the firing of a mine by an electric spark, for there all that the spark does is to produce a certain change in the arrangement of the particles of the grain or grains of powder with which it comes into contact, and this change is propagated from grain to grain through the entire mass. And as in this last case no one would dream of attributing the whole effect of the explosion to the force contained in the battery that produced the spark, or in the spark itself, so it seems to me equally illogical to attribute all the phenomena manifested during the life of say an elephant or an oak tree to the force, by whatever name we designate it, contained in the germ. Those phenomena must, I conceive, be regarded as the result of the properties of the matter of which the organism is composed, and the office of the germ is to initiate the changes to which this matter shall be subject, the ultimate form of the organization being determined by the arrangement of the particles in the germ, and the molecular motions which result from that arrangement.

This is no doubt hard to conceive. It may well seem incredible that the complete organization of an elephant or a whale should be the result of certain molecular motions imparted by an almost invisible cell to the elements that are brought into contact with it by the blood of the parent, and be due to the power of these elements to take up and to transmit these motions. And it is easy to understand how in view of this difficulty men sought for something beyond matter, a vital force, or a "*nisus formativus*," or even a present deity, to account for the phenomena. But possibly if we could realize the composition of this cell much of the apparent strangeness would disappear. The speculations of Sir William Thomson with regard to the dimensions of the ultimate atoms of which matter is composed, suggest that thousands of millions of these atoms may exist even in the microscopic cell which is the beginning of the organization of a mammal; and though we cannot attach any absolute value to his calculations, yet they suggest a minuteness of these atoms which is consistent with a complexity in the arrangements and motions of the particles of even the smallest fertilized germ corresponding to the complexity of the organism that may be ultimately evolved from it.

In all the changes we have described, however, there is to our apprehension nothing involved but matter and the properties of matter. The pollen that fertilizes the ovary of the flower of the wheat plant for instance was, as well as the ovary itself, probably only a few hours, certainly only a few days previously in the soil in the shape of inorganic matter, and all that has happened to this matter is that it has undergone certain changes in the arrangement of its ultimate particles in its passage through the vessels of the plant due to the influence of those vessels, which again have themselves only a short time previously been developed out of similar inorganic materials. And the only other factor in the process is the sun, whose influence is required to produce those molecular motions in the plant and in the material it absorbs which enable them to combine one with the other, and to undergo the various changes which result in the growth and maturity of the plant. This influence of the sun is indeed absolutely essential, since it is practically the only source of heat, to the surface of the earth, and without heat none of the changes I have described, I had almost said no changes whatever, would take place upon that surface. For whatever may be the truth of the doctrine of the conservation of force in ultimate analysis, supposing we had the requisite faculties and instruments, and the latter of these at least we do not now possess, yet to our limited apprehension there is a constant waste or rather loss of force on the surface of the earth which, but for fresh supplies received daily from the sun, would in a short time leave the whole world a lifeless desert. The matter which has been used up in any animal organism leaves it unchanged in its properties so far as its elements are concerned; the oxygen, carbon, nitrogen, hydrogen, phosphorus, iron, lime, &c., are there in precisely their original quantities, and with the same capacity of entering into new combinations which they possessed before they became part of an organism. But this capacity is, so to speak, latent, and can only become active by means of the forces imparted by the rays of the sun. These rays, as we term them, according to our present conceptions are vibrations of various kinds imparted to the ether, or whatever may be the transmitting medium, and by that to the surface of the earth. We have already distinguished three kinds of vibrations (or is it only that we have distinguished three modes of operation), the luminiferous, the calorific, and the actinic, or those which produce light, heat, and chemical action. These vibrations are, so to speak, taken up by various substances and transformed into internal movements of their particles among themselves corresponding to the elements of which the substance is composed and their position in relation to each other. And these movements in the living organism are the essential conditions, or perhaps we should rather say the active cause of the changes they undergo. In this process, so far as life is concerned, vegetables store up the force, so that in the shape of food and fuel it may serve the purpose of maintaining animal life. Animals however use up and dissipate this force, and so far as the evolution or conservation of life is concerned, this force once used is gone for ever. New force is needed in order that new combinations may be formed, and this force emanates exclusively from the sun; so that in the strictest and most literal sense the sun is "the life and light of all this wondrous world we see." It is indeed difficult to suppose that the force is lost absolutely, but its conservation is a conclusion of science founded upon abstract reasonings, and apparently contradicted by our daily experience. Matter emerges from every combination absolutely unchanged in amount and possessing always the same properties. We can weigh and measure and test the results of any decomposition, and secure to the minutest fraction every particle of the decomposed substance. When, however, that substance is a result of life-force, then once decomposed it can only again become organized by means of new force derived from the sun. But the effects of this force, the character of the form in which it shall be embodied, and the results it shall produce, are determined by the properties of the matter into which it is received, and the nature of the organism of which it for the time being forms a part.

In saying this, however, I am only speaking of those phenomena which are the result of organization. If there are any powers or faculties superadded to the organization and which do not result from it, whether in man or in the lower animals, these, of course, are not comprehended in the conclusions at which we have arrived. And the only remark I shall make upon this subject is that so far as man exhibits only higher and more perfect forms of faculties and sentiments which, in however inferior a degree, are possessed by the lower animals, it is obvious that we must attribute these faculties and sentiments to the same cause in each. If, in the lower animals, they may be regarded as the result of organization, then their more perfect manifestation in man must be assumed to result from the greater perfection of his organization. If, on the other hand, we assume them to be the result of something, whether soul or spirit, added to the human organism at or prior to birth, then we must equally assume that a similar addition has been made to the organism of any animal in whom they exist. If, for instance, we say that memory, judgment, reverence, gratitude, anger, love, hatred, jealousy, fear, hope, are due to the properties of the brain and nervous system when any of them are displayed by a dog or an elephant, so we must say in the case of the man. Or if in the case of a man we say that the brain is merely the organ of the mind or of the soul, having in itself as mere matter no power to feel or to reason, then we must say the same of the animals. And as when once we reach the lower animals it is impossible to find any point at which we can say that the faculties possessed by the more highly developed among them absolutely cease, since they pass by imperceptible gradations from the highest to the lowest, it would seem to follow that in this case we should have to insist upon the addition of a separate soul to every vertebræ animal at least, and possibly to every organism. Or, on the other hand, if starting from the lowest known organism we admit that the nature of their organization is an adequate cause for their various actions, then it appears impossible to find a point in which the addition of a soul is necessary. There is no chasm separating one class of organism from another so far as their properties are concerned. We find a gradually increasing specialization of the parts of the organism always accompanied by a corresponding specialization of their functions, and by an increasing complexity in the relations which they sustain to the external world, as well as in the actions which these relations involve; and of course the performance of these various actions implies a corresponding development of the faculties of which they are the consequence. While, therefore, I pronounce no opinion whatever upon the common theory of something superadded to man's material frame to which the manifestation of his higher faculties are due, I find nothing in the phenomena of life to support that opinion. Nor is it probable that anything of the sort should be found, even if its existence were beyond all question. It is assumed to be something which only manifests itself in and through our bodily organization, and there cannot in the nature of things be any scientific test by which its results can be distinguished from those of the organization itself. But, of course, science can no more disprove than it can prove its existence. That the faculties exist, and that they are in some way related to and dependent upon the organization, are facts of which the observance of every man will convince him. A man has only to notice the difference in his own mental and emotional state —whether he is exhausted or vigorous, hungry or satisfied, ill or in health—and the difference in those of others, whether they are drunk or sober, to have no doubt that not merely mental and emotional but even spiritual conditions are

intimately connected with the states of the body. But whether they result from forces inherent for the time in the matter of which the body is composed, or whether they are the result of an unextended something added to that matter, is a question to which, it seems to me, science has no answer to give.

If then we conceive of life and growth as the result of the properties of matter in certain combinations we are able, in some measure, to understand how it is that all organized beings have been and continue to be formed upon one type, since we must assume that to be the form in which these combinations of matter tend to arrange themselves, just as the forms of crystalization of any given substance are due to the tendency of its molecules to arrange themselves in that form: and this is at present an ultimate fact to us, though one which further investigations may possibly enable us to explain. It is noticeable that there is a similarity between the forms of many of the lower organizations, whether plant or animal, and those of some crystals, suggesting that there may be a real analogy between the modes of operation of the two forces of which crystalization and organization are the respective products. And, of course, every organism must have a relation to the medium in which it lives, the nutriment it assimilates, and the earth upon which it moves, or is fixed, or the water in which it swims, and these relations must have their effect in determining the mode of growth and the form of the organism. There will also be differences resulting from the direct action of the medium upon the parts of the organism which are exposed to it, as we see in the different durnal coverings of fishes and land animals. And as the condition of life is the assimilation of new matter, either to enable the organism to grow or to supply the place of that which has been used up in the performance of its various functions, and, in animals, the excretion of old matter, which having become useless would soon be injurious, and the presence of oxygen is necessary to these processes, there must, in the midst of the differences to which I have referred, be analogous contrivances for obtaining the matter to be assimilated, for the removal of effete matter, and for securing the needful supply of oxygen. And these various necessities imply the existence of corresponding organs, since otherwise they could not be satisfied. And thus we can go a little further in our conclusions, and see dimly the causes which have determined many or most of the special arrangements of the various organizations.

This, however, does not enable us to understand why reproduction should be a function of organization, or the cause of the specific identity between parent and offspring, or of the individual differences that exist. Nor do I pretend to suggest an explanation. With regard to variations, however, I should be disposed to attribute a large direct influence to changes of food and of the conditions in which an animal may be placed. If the form of the animal is the result of the properties of the elementary substances of which it is composed, directed by the influence of the germ and controlled or limited by the influence of the medium in which it is placed, then, though the ultimate elements are substantially the same whatever may be the nature of the nutriment, yet their proportions and combinations may so far differ as to render them less apt to assume the forms proper to the organization into which they are taken, and more ready to assume other forms. And where changes in the two factors, the nature of the nutriment, and the character of the external conditions concur, there may be a correspondingly rapid change in the character of the organization, more being effected in the course of years than would under a continuance of the original conditions be effected in centuries. And this may be chiefly the result of modifications in the germ and fertilizing elements, which may be assumed to be more susceptible of any modifying influences inasmuch as they are not, strictly speaking, parts of the parent organization; in which case their form would necessarily be determined by that organization, but are new products, having an individual existence dependent upon but not identical with that of the parents.

It is quite true, however, that these considerations carry us but a very short distance towards the solution of the question whether the doctrine of evolution is or is not true. But to myself the realization of the fact, as it appears to me, that all growth is an evolution due to the properties of the matter which enters into the organism, removes one of the greatest difficulties in the way of the acceptance of the theory. There is nothing intrinsically more wonderful in the development of the species man from the lowest organism, or even from a structureless mass of vitalized matter which has not yet become organized, by gradual changes operating perhaps upon millions of intermediate forms, each one slightly differentiated from its predecessor, than there is at the present day in the development of the individual man from a structureless germ, passing through intermediate forms which resemble though they are not identical with the embryonic forms of the lower types of animal life. The one process is not a whit more mysterious than the other, for both at present are beyond our power to understand or explain. Our familiarity with the fact that offspring are born which resemble their parents in all specific characters prevents us from feeling how great a marvel is involved in the one, and our most imperfect information with regard to the changes which even now may be taking place around us, and still more with regard to those which have taken place in the past history of the world, increases the apparent improbability of the other. But our investigations make us aware of the mystery of the familiar process, and though they do not in any way remove the mystery of the other, at least they render it less improbable, if they do not show it to be the only rational explanation of the phenomena. I know how difficult it is to acquiesce in the idea that all the varied manifestations of life with which we are familiar are the product of the properties of substances which we are accustomed to consider as inert in themselves. The apparent disproportion between the instrument and the result shocks our sense of fitness, and we can hardly conceive that consequences so vast and so varied should be produced by causes so minute and inconspicuous. But science has shown that no particle of matter is really inert, and that there is a constant action and reaction between its particles—that, indeed, no two particles of matter can be brought into contact without exercising a mutual influence. Even those forms of matter which by their constancy of form and their apparent inability to enter into any new combinations seem most to possess the quality of inertness, owe their properties to the intense action of their particles upon each other. What, for instance, must be the force of attraction between the particles of carbon when crystallized into a diamond to enable them to resist the effects of attrition as they do? And the same element of carbon, which is so unchangeable in this particular form, is most ready in its ordinary state to enter into combination with other elements, and is conspicuous for the part it performs in both animal and vegetable life. And all the other elementary substances display their power in a similar manner by the permanence and comparative indestructibility of some of their forms, and by the varied combinations with which they are ready to enter, and the effects which these combinations produce. Nature, too, is full of examples of the production of vast results by the continued operation of comparatively insignificant causes. The degradation of mountain chains by the effects of rain and the manner in which each little rivulet bears its contribution to the formation of new tracts of land at the mouth of the river into which it flows; the growth of coral reefs from the combined labour of minute organisms of the lowest type, the formation of the immense beds of chalk chiefly from the exuviæ of microscopic animalcules, are illustrative of this. And if sufficient time is allowed there is no limit to the effects that may be thus produced. But, unquestionably, these illustrations though they may tend to diminish this source of objection to the view I have taken do not remove it, since there appears at first to be an absolute distinction between such phenomena as those to which I have just referred and the phenomena of life and organization. It may be said that the one class are material effects due to material causes, so that there is a congruity between them, while some at least of the phenomena of life, sensation among the rest, which is a constant property of animal organization in all but the very lowest forms, is not material, and therefore must be due to something else than a material cause. But it may be a question how far this distinction is founded in the nature of things—whether there is any such break between non-vital and vital phenomena, even the very highest, as to necessitate or allow the introduction of some new power which does not belong to the substances of which the animal is composed. And, at least, the bodily form is a material phenomenon, and the result of material agencies. And the same is the case with all that is the effect of this organization, whether much or little.

There is one objection to the theory of development to which before concluding I may briefly advert, that founded upon the phenomena of hybridity—that unions between the male and female of different species are almost always infertile, or where they result in the production of offspring those offspring are for the most part incapable of re-production, either from the first, or at the latest in one or two generations; while crosses between varieties are almost invariably fertile, and their offspring frequently more vigorous than those of the pure breed. But upon this matter we hardly seem to know enough to enable us to draw inferences. That too close an alliance between the parents is injurious to the offspring, and in the long run tends to its deterioration and even extinction, appears to be established; and if that is the case we may understand that too great a dissimilarity between them may produce similar results. And when we look at the essential features of the development of a germ, that it is the consequence of some change in the condition of the ovum produced by the contact and (presumably) absorption of the fertilizing element, and results in a growth which is not in the direction of either of the parents simply, but in a direction compounded of the two, it will be seen that it is necessary there should be a certain homogenity between the organization of the parents to allow of this compounded result being produced. It would seem that in almost all cases in which it is possible to test the results the addition of the fertilizing element initiates this change in the ovum, but that in the majority of cases of attempted crosses between different species growth is arrested after a longer or shorter

interval, and we may presume that the period of the arrest depends upon the greater or less heterogenity of the blended elements. Thus viewed these phenomena are evidences only of the fact that such differences exist in the particular organisms which it is attempted to blend, and can bear no testimony to the causes to which these differences are attributable, whether to modification by means of natural selection, or to distinct acts of creation. Nor, probably, would any difficulty have been felt on this account but for the circumstance that in the case of varieties produced by man, although the structural differences may be greater than exist between many species, yet the unions of individuals of these varieties are uniformly fertile. And this appears to show that no amount of heterogenity in the descendants of a common ancestor will render the unions among them infertile. But apart from all other considerations we must remember that it is a question whether man has ever succeeded in producing a variety which would keep true of itself without constant selection; whether, even though preserved free from intermixture with other varieties, it would not revert more or less to the original form if those of the offspring which departed from the selected type were not weeded out or prevented from breeding. And so long as this tendency to reversion exists there cannot, it would seem, be any such heterogenity between these varieties as to entitle us to expect that their union would be infertile.

I have thus, not indeed completed the subject, but have brought my paper to a conclusion. I have, indeed, only touched upon one part of it, for I found that the whole question was too wide to be adequately treated in a single paper. And I feel the imperfection and incompleteness of the views I have attempted to set forth. I was, indeed, more than once tempted to abandon the task, but I thought it best to proceed, trusting that I might, at least, help in offering some hints as my contribution towards the elucidation of a topic of great interest and obscurity.

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